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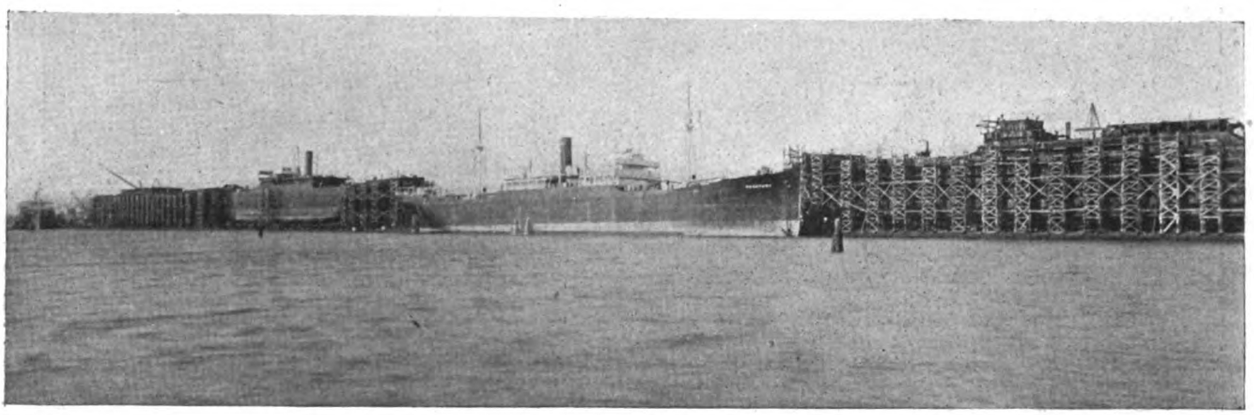

Fig. 1.—Waterfront of Pensacola Shipyard, Showing Building Berths

Southern Shipbuilding Activities

Steel Ships Aggregating 600,000-Deadweight Tons Built in Southern Yards Since January, 1919—Description of Pensacola Shipyard

DURING the past three years the South has made rapid advances in demonstrating the advantages of its geographical location for manufacturing enterprises. This has been brought about through the demands of the emergency requiring the establishment of additional facilities for supplying the immediate and future needs of the country. Far-seeing corporations, recognizing the necessity of uninterrupted operations to obtain maximum efficiency with minimum costs of production, have located in areas which permit the continuing of work throughout the year, without hindrance from snows and the elements of the winter months. This requirement is particularly pronounced in the shipbuilding industry, where possibly 90 percent of the work is done in the open, and favorable weather conditions are imperative to maximum success.

This great, practically new, American industry in its recent rapid expansion has met with marked success in the South, and is now represented by plants at all of the principal ports. In the southern Atlantic and Gulf district the steel shipyards have launched, delivered and placed in process of construction since January, 1919, more than 600,000 deadweight tons of steel cargo ships and tankers, and with their present equipment have an annual capacity of approximately this tonnage. These Southern

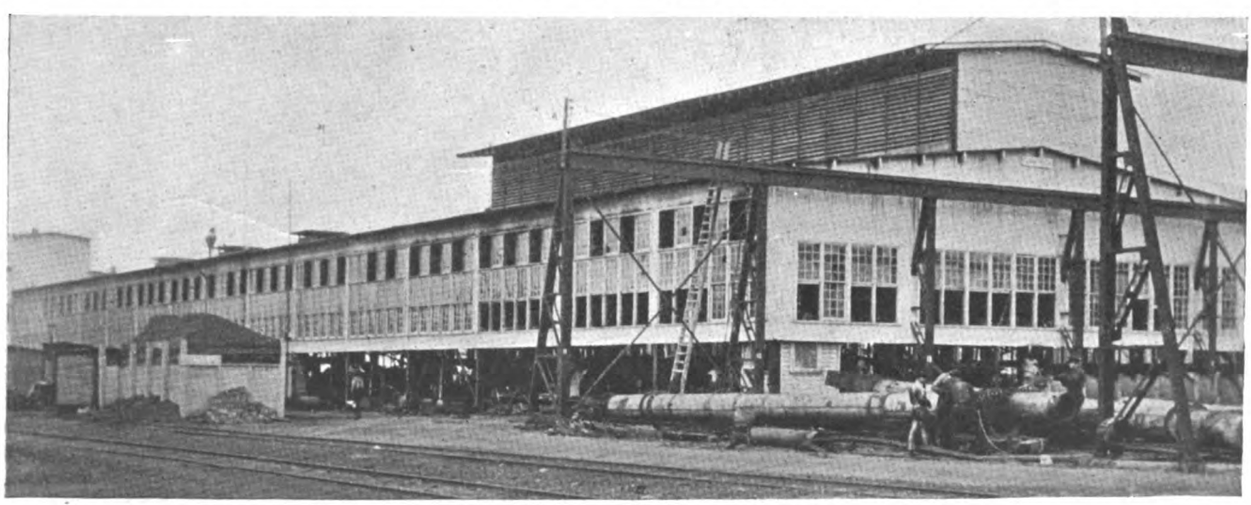

Fig. 2.—Forge Shop at Pensacola Shipyard

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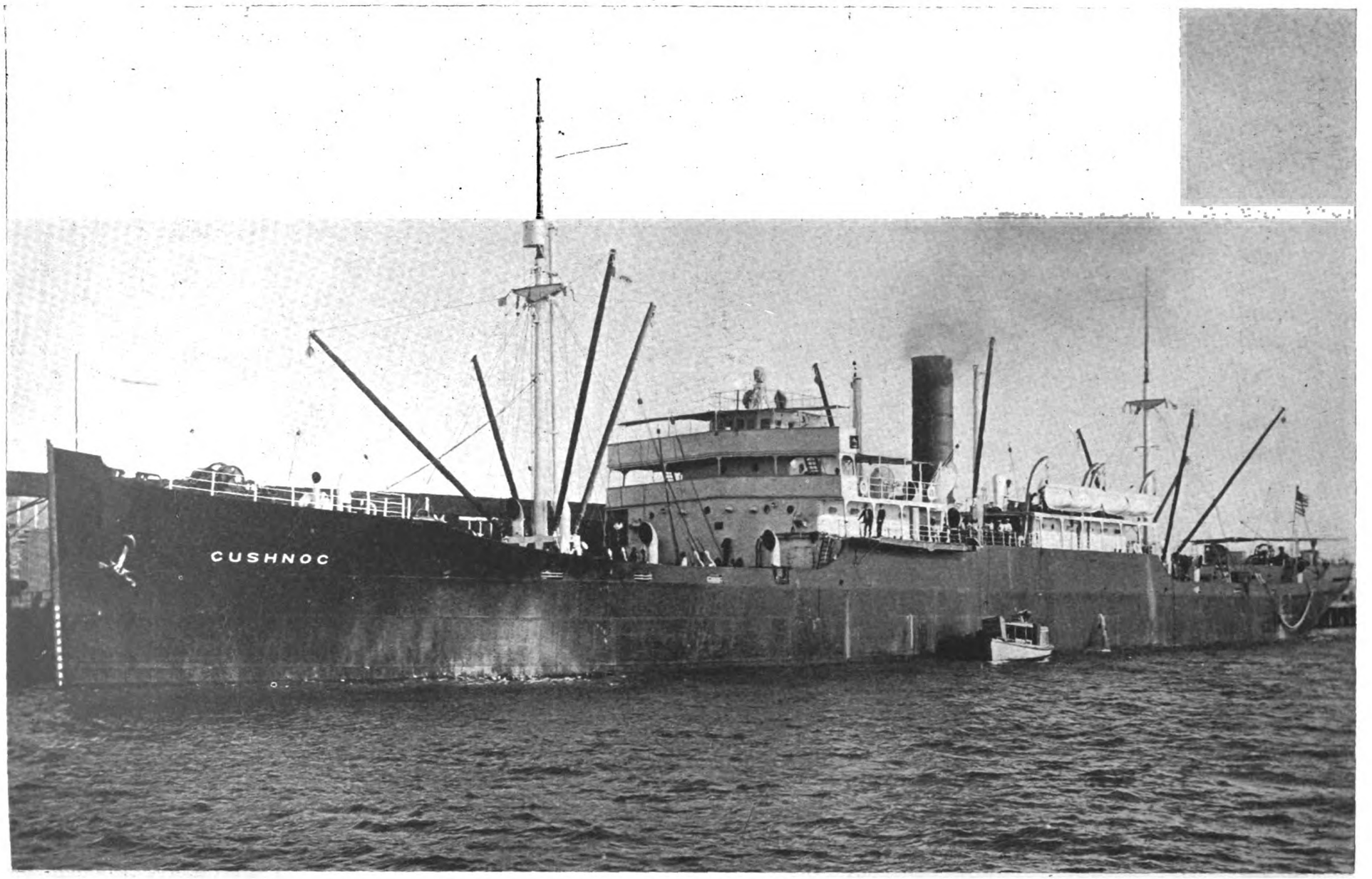

Fig. 3.—Steamship *Cushnoc*, Built by Pensacola Shipbuilding Company, Loading for Maiden Voyage

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Fig. 4.—Launching of S. S. *City of Sherman* at Pensacola Shipyard on January 14, 1920

yards have had remarkable success in turning out ships of the highest class, and this is principally due to the favorable climatic conditions and the available supply of willing and unhampered labor.

THE PENSACOLA SHIPYARD

An example of the permanency of this new Southern industry is the plant of the Pensacola Shipbuilding Company at Pensacola, Florida. This plant is located on approximately 131 acres of land, within the city limits of Pensacola and borders Bayou Chico, an inlet from Pensacola Bay. The erecting berths have a length of 2,800 feet, and provide for side launching. Fig. 4 shows the hull of a 9,000-ton ship launched with the entire ship, including mechanical work, 98 percent complete.

The layout is so arranged that steel vessels with dead-

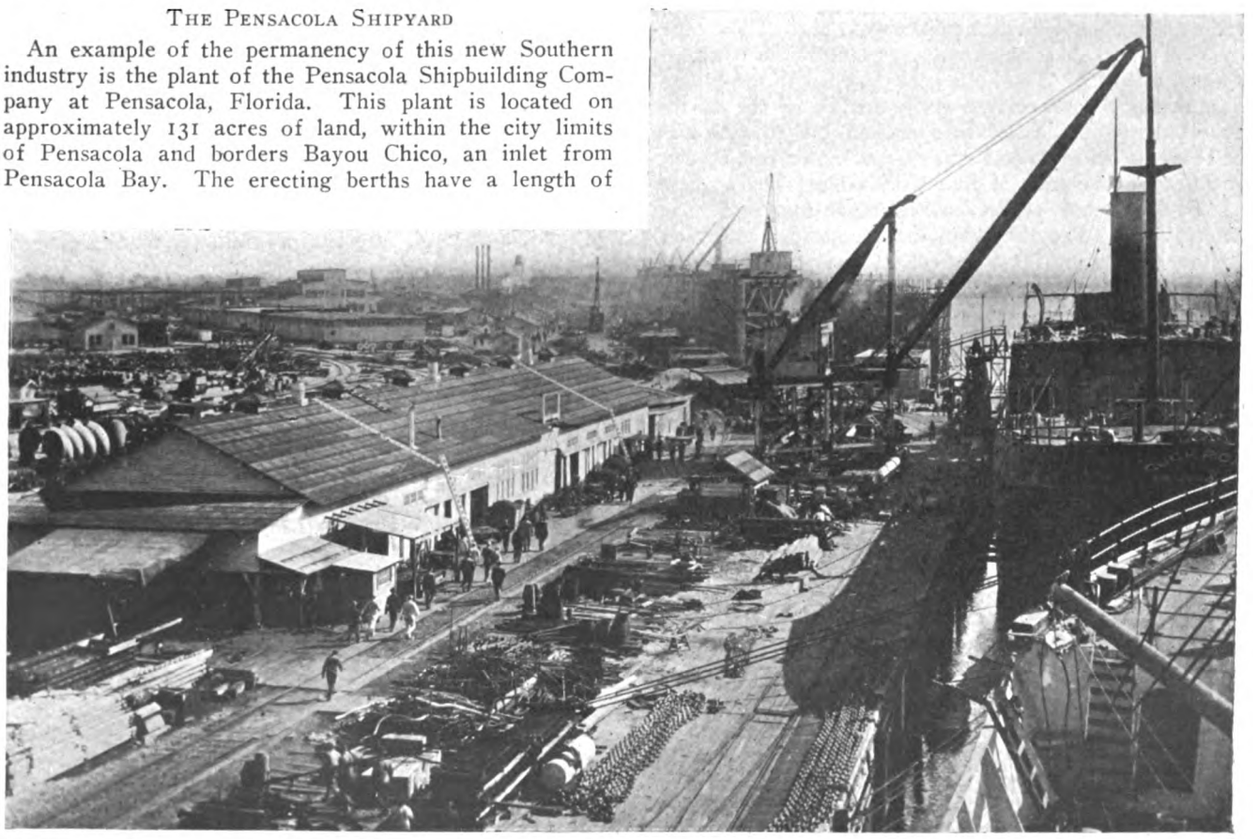

Fig. 5.—General View of Pensacola Shipyard Looking East, Showing Fitting-Out Dock in Foreground

Fig. 3.—Steamship *Cushna*. Built by Pensacola Shipbuilding Company. Loading for Maiden Voyage

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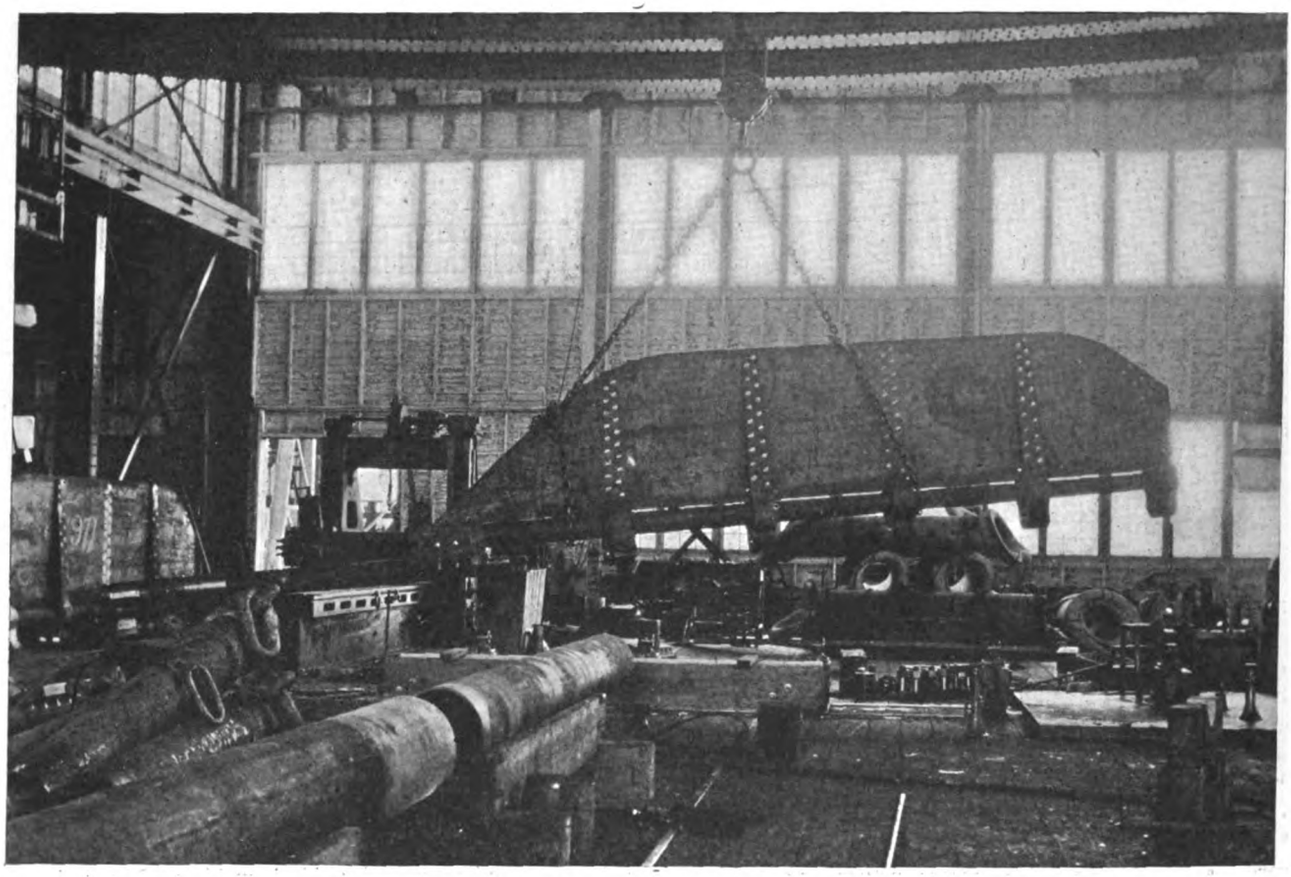

Fig. 6.—Interior of Machine Shop at Pensacola Shipyard, Showing 20-Ton Rudder on Crane

weight capacities up to 15,000 tons can be built without changing any of the equipment. At the present time these berths are accommodating five 9,000-ton deadweight capacity steel cargo ships in consecutive lengthwise positions, as noted in Fig. 1. The hulls are erected with tower gantries, which can travel the entire length of the berths. Five of these gantries are in operation, one to each hull, but they are so arranged that two or more can be concentrated on one hull, if found desirable. The gantries have 80-foot booms with capacities of 10 tons with a 30-foot reach, and five tons with the booms in a horizontal position. The gantries are electrically operated and are extremely economical on account of the one-man control. Storage racks for fabricated materials are placed close alongside of the gantries in a line parallel with the hulls, and the transferring of the steel from the racks to the hulls is done without lost motion on account of the compactness of the arrangement and the close proximity of the racks, gantries and hulls.

LAYOUT OF THE YARD

This same arrangement of avoiding lost motion has been followed in the layout of the entire plant. Material entering the gate continues always in a forward motion through the shops to the docks, by means of a system of tracks which are carried on an inclination to the last hull and outfitting dock. The general arrangement of the yard is graphically shown in Fig. 5.

OUTFITTING DOCKS

The outfitting dock is a continuation of the erecting berths and has a length of 1,000 feet. This dock is provided with one 25-ton and one 50-ton stiff-leg derrick, for lifting heavy mechanical parts and outfitting materials. It is also provided with an auxiliary power equipment, machine shop, pipe shop, rigging loft, etc., making the quick handling of materials possible.

The plant has its own powerhouse, furnishing both alternating and direct current for the operation of all mechanical devices. The power plant is equipped with three 350-horsepower Page Burton watertube boilers, arranged for either oil or coal burning, which develop somewhat over 1,400 indicated horsepower. Four steam-driven and two electrically-driven compressors furnish 6,000 cubic feet of free air per minute, maintaining a constant pressure of 100 pounds during working hours. Flow meters have been installed in the air machines, and by checking the number of pneumatic tools and appliances in use at peak load time, it is possible to compare the amount metered with the estimated required consumption. In case of any great variation the cause is immediately investigated, and air leaks and waste of air are brought down to a minimum. This method of controlling the air supply accounts in a great measure for the excellent records secured in the driving of rivets, the Pensacola yard exceeding all other yards in the Southern district in the number of good rivets driven per gang hour.

The fabricating and machine shops have all modern equipment, as shown by Fig. 6, and have capacities considerably in excess of the present requirements.

The Pensacola Shipbuilding Company is completing ten 9,000-ton deadweight capacity steel cargo ships, one of which is shown in Fig. 1. Six of these ships have been placed in service, and four of them have delivered their first cargo to Europe. The vessels are completed in every respect in the wet basin before being turned over to the operators, the average time required to install the machinery and complete the outfitting being 30 days.

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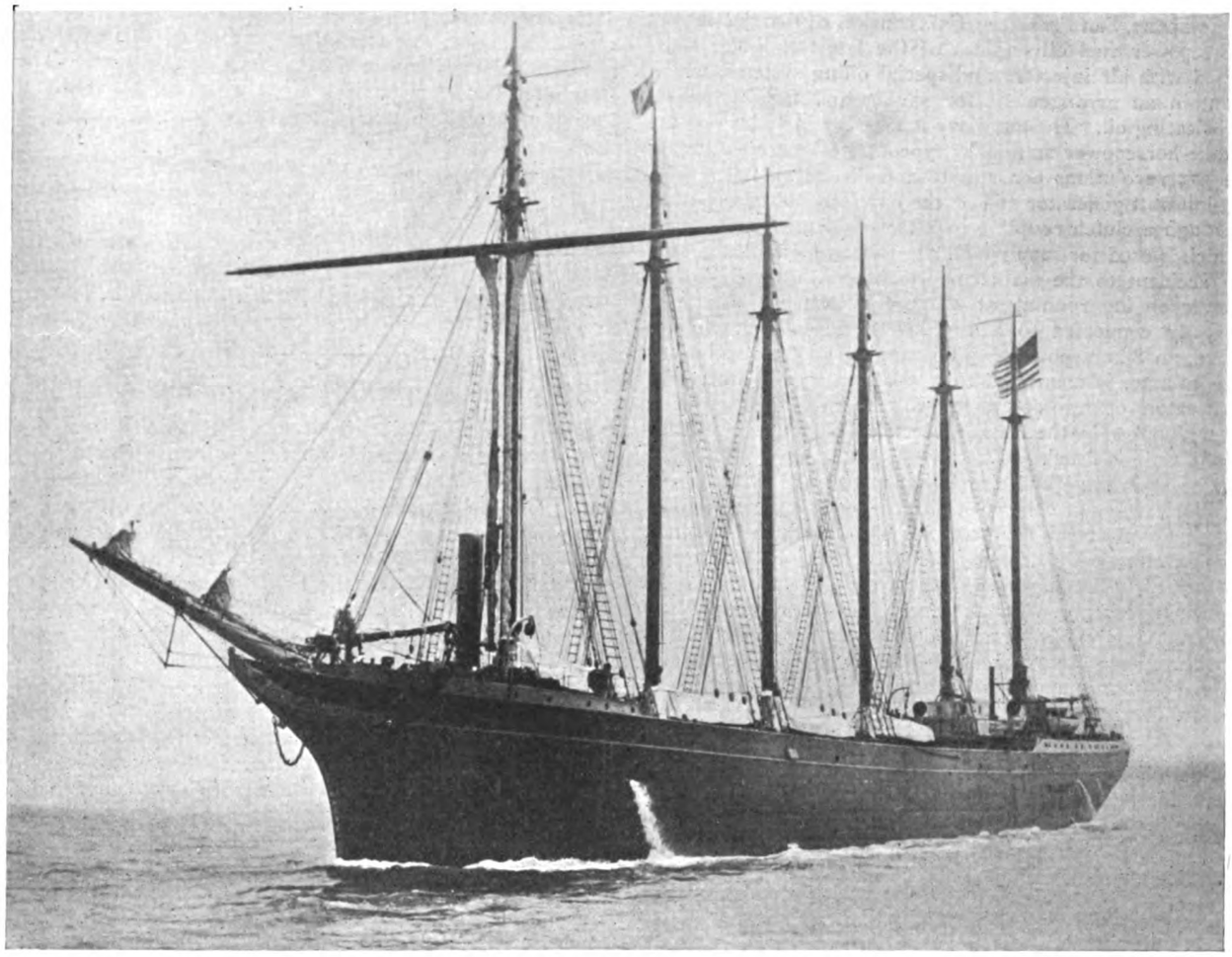

Motorship *Katherine*, Converted from a Four-Masted Sailing Ship Into a Six-Masted, Bald-Headed Schooner, to Be Used as a Vegetable Oil Tanker

New Uses for Old Sailing Vessels

Former British-Built Schooner Katherine Converted into Motor Vegetable Oil Tanker for American Company

IN the development of the motorship many vessels that have not been economically successful in a former state have become of value commercially after the installation of Diesel or semi-Diesel oil engines. This fact was well demonstrated at the recent trials of the *Katherine*, the latest addition to the fleet of motor tankers, owned by the Philippine Vegetable Oil Company.

Tht *Katherine* was formerly a four-masted, square-rigged, iron sailing ship, but has been converted into a six-masted, bald-headed schooner for the purpose of taking advantage of favorable winds, although it is intended that her engines shall be the main source of power and run continuously when the vessel is on a voyage.

As converted, the principal dimensions are as follows:

Length overall	286	feet 9 inches
Length between perpendiculars	275	feet 0 inches
Breadth molded	43	feet 5 inches
Depth molded	24	feet 1 inch
Gross weight	2,196	tons
Net weight	2,087	tons
Engines	2	Bolinder fuel oil
Brake horsepower	640	
Speed	8	knots

The hold of this vessel is divided into ten tanks, having a total oil capacity of 3,000 tons at a draft of 22 feet. An elaborate and efficient system of heating has been devised for regulating the temperature of the cargo, and by means of centrifugal pumps the tanks can be emptied in about ten hours. Two oil-fired Scotch marine boilers having a heating surface of 900 square feet and a working pressure of 150 pounds per square inch are installed for furnishing steam to the cargo-heating system and for supplying power to the pumping machinery.

In addition to the main pumping system the equipment includes a secondary drainage system of pumps to take care of oil below the suctions of the main plant. The entire cargo-pumping equipment, consisting of two duplex steam pumps, having cylinders 16 inches and 19½ inches diameter by 12 inches stroke, one auxiliary pump with cylinders 6 inches and 4 inches diameter by 4 inches stroke, one fire pump with cylinders 6 inches and 4 inches diameter by 6 inches stroke, is installed in the pumping room situated in the forward part of the ship between oil-tight bulkheads.

The main power plant, supplied by Messrs. Henry Lund

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& Company, San Francisco, Cal., consists of two 320-brake-horsepower fuel oil engines of the latest Bolinder type, fitted with air injectors and special oiling systems, which contain an arrangement for saving and filtering waste lubricating oil. The auxiliary machinery includes one 25-brake-horsepower stationary type fuel oil engine running at 375 revolutions per minute and directly coupled to a 15-kilowatt generator and on the opposite end of the shaft through a clutch coupling to a two-stage air compressor, which is used for supplying air to the main engines in case of accident to the main compressor. A 15-brake-horsepower engine running at 450 revolutions per minute is directly connected to a 10-kilowatt generator, while a third, an 8-horsepower engine running at 550 revolutions per minute, is connected to a 5-kilowatt generator. All generators operate at 110-125 volts. An electric steering gear, supplied by the Herzog Electric Company, San Francisco, Cal., is fitted.

The main bilge and circulating pumps are driven from the forward end of the crankshaft of each engine. Auxiliary pumping machinery consists of one 4-inch by 6-inch triplex electrically driven pump with suctions to the sea as well as to the bilge; one electrically driven 6½-inch by 8-inch triplex pump for fire and bilge service, as well as for emptying and filling cofferdams directly connected to a 20 horsepower motor; one 3-inch by 4-inch electrically driven sanitary pump directly connected to a 3-horsepower motor.

Arrangement of Fuel Oil Tanks

Fuel oil tanks having a capacity of 2,200 barrels, sufficient for one hundred days' running, are carried in the double bottom under the pump room and aft of the engine room. In the forward part of the engine room two circular day tanks, each holding 26 barrels, are placed together with two circular tanks for storing 3,000 gallons of lubricating oil. The latter are connected through filters to the lubricating day tanks.

In addition to other equipment, the *Katherine* is fitted with a complete refrigerating plant, consisting of one motor-driven Jarvis ice machine having a capacity of 1¼ tons per day and nearly 1,000 feet of refrigerating space for ship's stores. The vessel has 20,000 cubic feet of dry cargo space besides the space in the hold occupied by the oil tanks. To handle supplies of a bulk character, four winches are provided. A complete wireless outfit having a range of 3,000 miles is also installed.

Accommodation is provided for the captain and officers in the aft part of the ship, while the crew is quartered forward.

Acceptance Trials of the Katherine

After alterations on the ship had been completed at the Hanlon Dry Dock & Shipbuilding Company's plant, Oakland, Cal., under the supervision of D. W. and R. Z. Dickie, naval architects, San Francisco, Cal., the *Katherine* proceeded to San Francisco Bay, where several runs were made over a measured mile course. The results of the trials showed that running with the tide an average speed of 9.06 knots was maintained, while against the tide the ship was able to average 7.02 knots, or a combined average of slightly over 8 knots. During the trial the ship was fully loaded, the cargo tanks having been filled, giving a draft forward of 20 feet 2 inches and aft 20 feet.

Shipbuilding in Canada.—Canada's shipbuilding industry, according to *Commerce Reports*, now employs about 25,000 men, while approximately another 25,000 are engaged in the manufacture of marine equipment and supplies. It is claimed by the same authority that the industry represents an investment of about $50,000,000 of capital, and that more than 90 percent of this progress has been achieved within the last four or five years. The Dominion Government has already appropriated about $70,000,000 for shipbuilding and some further appropriations are said to be under consideration. There is discussion of the expediency of giving out contracts for steel freighters and passenger ships for the National Merchant Marine, to be bonused on the basis of $10 per ton for all steel ships built in Canada that conform to certain standards of construction. The Government has also offered to aid wooden shipbuilding in British Columbia by loaning 75 percent of the capital cost of vessels built there.

Ship Surgeons Operate on the Avalon

REHABILITATED from a vessel minus bow and stern to a veritable floating palace, the steamship *Avalon*, owned by William Wrigley and associates, recently left the Brooklyn, N. Y., yards of the Morse Dry Dock and Repair Company, to pass through the Panama Canal; and thence to the waters of the Pacific. Plying between San Pedro and the Santa Catalina Islands, this ship will aid in the development of the city of Avalon and the Santa Catalina Islands, upon which Mr. Wrigley and associates have developed and sold more than a million dollars' worth of property.

Bespeaking the wonderful skill of modern ship surgeons, the *Avalon* with her stem and stern grafted to their natural places has been transformed from a battle-scarred appearance to a thing of beauty with two dance halls, de luxe cabins and woodwork costly and resplendent and so arranged as to obscure all inside piping and wiring. Since the signing of the armistice, when the United States Government halted work on her, this vessel has acquired, in addition to her wonderful appointments, her normal length, which had been reduced by 40 feet in the process of amputating her at bow and stern.

Once in the process of conversion as a United States troop transport to be known as the *Blue Ridge*, plying in the submarine infested waters between Calais, France, and Dover, England, the *Avalon* will now carry California visitors and excursionists between San Pedro and the City of Avalon, and, though ultra-fashionable in dress, she will be quite democratic in spirit, carrying anything from a milliner's hat box to a player-piano for a Santa Catalina bungalow.

A sturdy, well-preserved ship, the *Avalon* was coveted by the Government during its war-time need of tonnage. She was then in the vicinity of Chicago. The demand for tonnage became more and more urgent and the Government decided to send her to Boston for conversion.

To make this trip, the *Avalon* was required to pass through the locks of the Lachine canal, above Montreal. As the vessel was 277 feet 8 inches long and the locks of the canal did not permit a boat of this size to pass without closing its yawning gates, she was sent to a Chicago shipyards, where her length was reduced.

The severed plates of bow and stern were placed in the forward part of the ship and, surprising as it may seem, the *Avalon* proceeded to Boston under her own steam. In that city, the din and noise of riveters' guns ceased with the boom of European artillery and Mr. Wrigley and others purchased her from the Government.

She was towed from Boston to the Brooklyn, N. Y. yards of the Morse company, where her rehabilitation, even to a fuel oil-burning system, has been made so complete. The *Avalon* has a passenger-carrying capacity of 2,000, and is capable of a speed of 22 knots.

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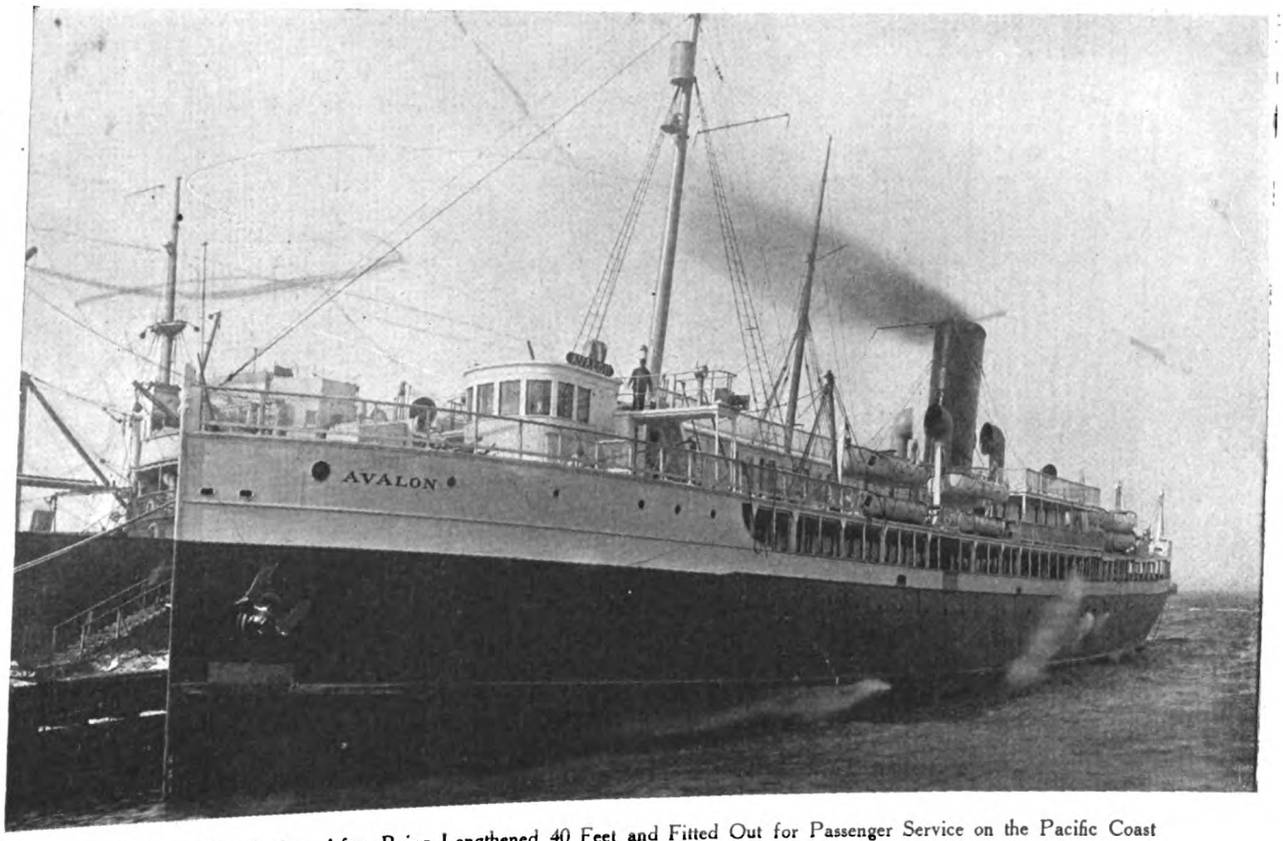

Fig. 1.—S. S. *Avalon*, After Being Lengthened 40 Feet and Fitted Out for Passenger Service on the Pacific Coast

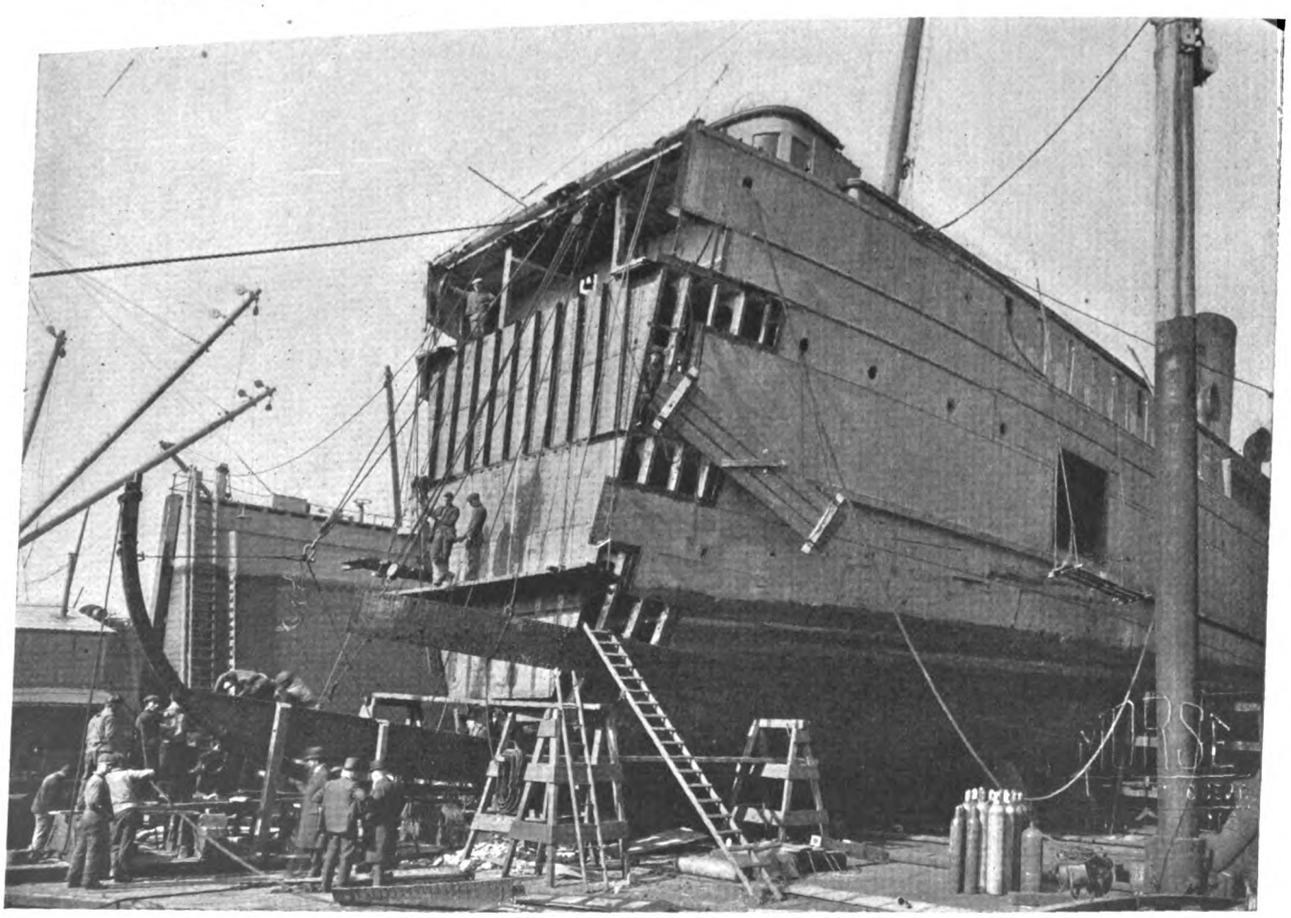

Fig. 2.—Restoring the Bow of the *Avalon* in One of the Dry Docks of the Morse Dry Dock & Repair Company

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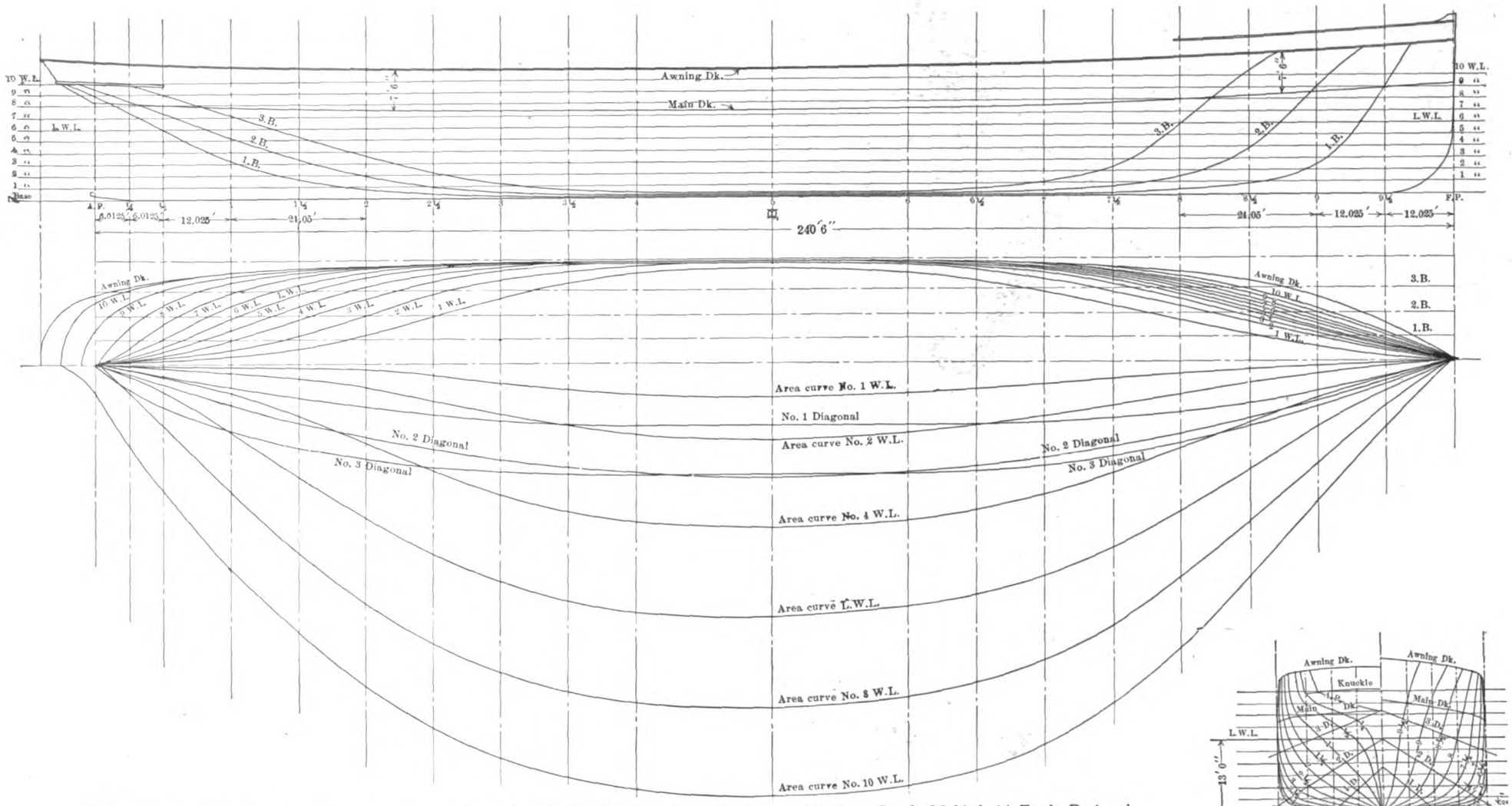

Fig. 1.—Lines of Twin-Screw Steel Passenger Steamer (Length, 240 Feet 6 Inches; Breadth, 37 Feet 3 Inches; Depth, Molded, 16 Feet), Designed for Union Steamship Company, Vancouver, B. C.

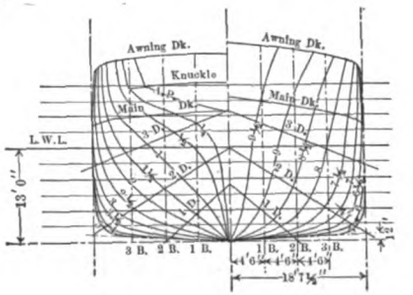

Fig. 2.—Body Plan

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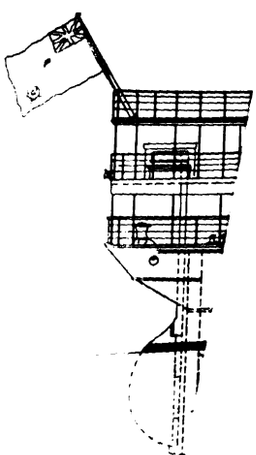
Fig. 2. Body Plan



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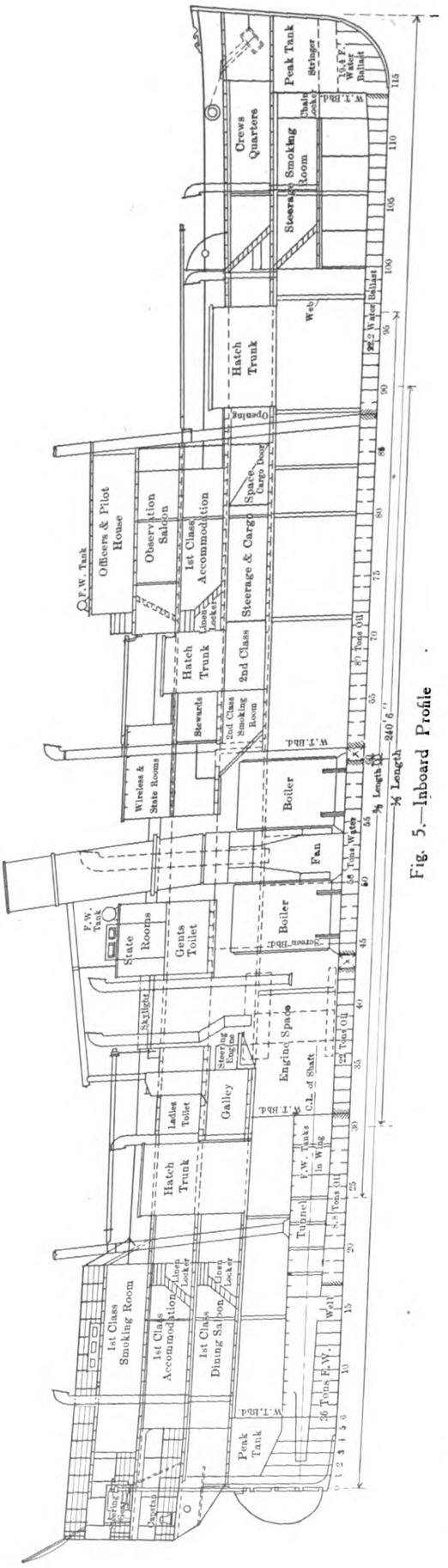

Fig. 5.—Inboard Profile

Twin-Screw Coastwise Passenger Steamer

Plans for 16-Knot Vessel of 2,000 Tons Displacement With Accommodations for 330 Passengers

TENDERS for the construction of a twin-screw steel passenger and cargo steamer of about 2,000 tons displacement and 16 knots' speed, designed by Henry Darling, consulting engineer and naval architect, Vancouver, B. C., are being asked by the Union Steamship Company of British Columbia, Ltd., Vancouver, B. C. The vessel is intended for service on the northern coast route between Vancouver and Prince Rupert. The design, as shown in the accompanying plans, calls for a vessel of the following dimensions:

Length overall	251 feet 6 inches
Length between perpendiculars	240 feet 6 inches
Beam, molded	37 feet 3 inches
Depth, molded	16 feet
Depth to awning deck	23 feet 6 inches
Draft, mean load	13 feet
Displacement to molded lines	2,012 tons
Block coefficient	0.604
Area of load waterline plane	6,819 square feet
Coefficient of load waterline plane	0.76
Area of midship section	457 square feet
Coefficient of midship section	0.945
Tons per inch immersion	16.15
Distance of center of buoyancy aft or No. 5 ordinate	5 inches
Indicated horsepower	2,800
Speed	16 knots

The vessel is to be built with a cellular double bottom to British Corporation rules for the highest class. Accommodations will be provided for 98 first class, 32 second

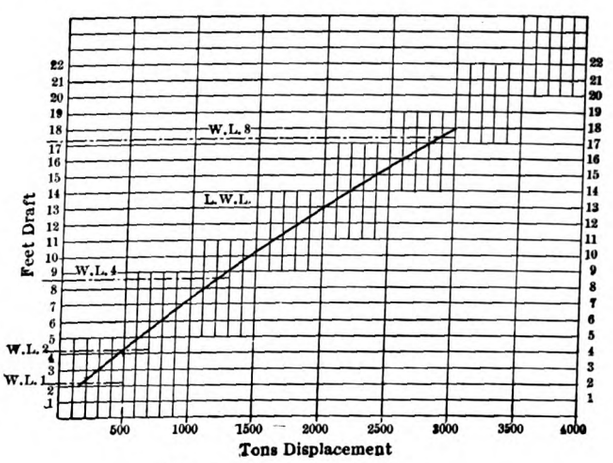

Fig. 6.—Displacement Curve

class, and 56 officers and crew in staterooms and cabins; and also, for 200 steerage passengers in portable berths. Special provision will be made for all sanitary fittings throughout, hot and cold water being supplied to all accommodations. The vessel will have a large cold storage room and a well-arranged galley, capable of meeting the needs of 150 passengers at one sitting. The vessel will be heated with steam and lighted with electricity.

Quarters for the captain and officers are on the bridge. A large first-class smoking room and an observation saloon are located on the boat deck. The first-class staterooms are on the boat and awning decks. The dining room, second-class mess room, cabins and smoking room are on the main deck. The engineers, petty officers and crew are berthed on the main deck, while the steerage berths are also on the main deck with the smoking room on the lower deck.

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Cargo will be handled through three hatches, by means of steam winches and derricks capable of lifting three tons each. The vessel will be fitted with a steam windlass, steam steering gear, steam capstans, repeating tele-

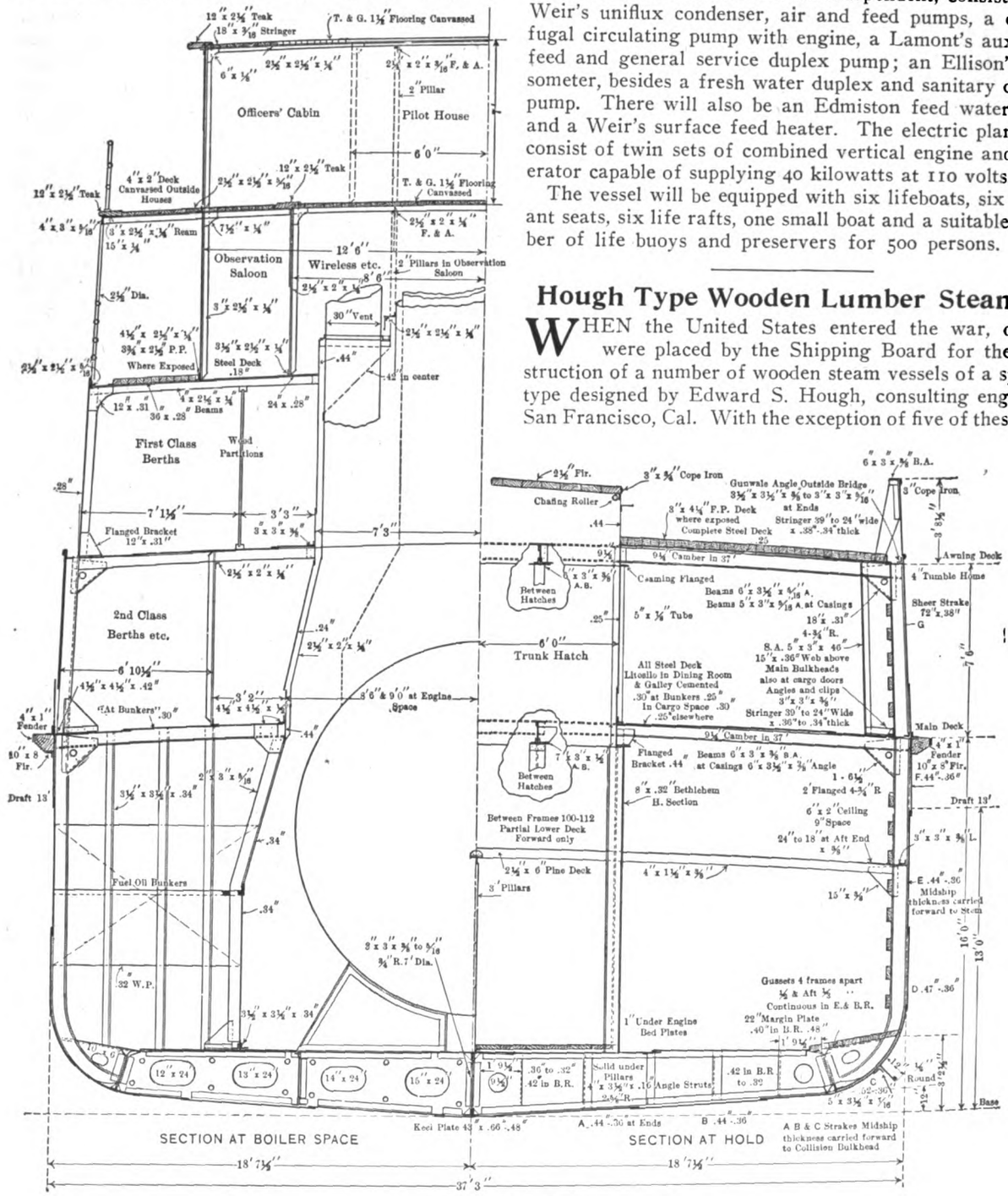

Fig. 7.—Midship Section

graphs for operating and docking the vessel and all modern appliances for navigation, and the handling of cargo.

Propulsion will be by twin screws actuated by either triple expansion reciprocating engines or double reduction geared turbines capable of developing 2,800 indicated horsepower, which, it is estimated, will give the vessel a speed of 16 knots. Steam will be supplied at a pressure of 185 pounds per square inch, by two Scotch boilers 16 feet in diameter by 11 feet 6 inches long, each having four Morison corrugated furnaces. The boilers will be fitted with Howden's patent heated forced draft and for oil fuel burning, the furnaces being fitted with Coen's patent oil burners.

All of the auxiliaries will be independent, consisting of Weir's uniflux condenser, air and feed pumps, a centrifugal circulating pump with engine, a Lamont's auxiliary feed and general service duplex pump; an Ellison's pulsometer, besides a fresh water duplex and sanitary duplex pump. There will also be an Edmiston feed water filter and a Weir's surface feed heater. The electric plant will consist of twin sets of combined vertical engine and generator capable of supplying 40 kilowatts at 110 volts.

The vessel will be equipped with six lifeboats, six buoyant seats, six life rafts, one small boat and a suitable number of life buoys and preservers for 500 persons.

Hough Type Wooden Lumber Steamer

WHEN the United States entered the war, orders were placed by the Shipping Board for the construction of a number of wooden steam vessels of a special type designed by Edward S. Hough, consulting engineer, San Francisco, Cal. With the exception of five of these vessels, which were unfinished at the time of the signing of the armistice, all of them have been in service at sea and at the present time are trading all over the world. One of the unfinished vessels, the *Anson S. Brooks,* has been converted, as shown in the accompanying plans, to meet the requirements of the lumber trade on the Atlantic Coast and West Indies, with return cargoes of sugar or other commodities. Duplicates of this vessel have been running and are still operating very largely in the general cargo trade to the Hawaiian Islands, bringing back sugar and fruit.

In converting the *Anson S. Brooks* into a lumber car-

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rier, all of the 'tween-deck accommodations were eliminated, allowing, with the space gained by fitting oil fuel in place of coal, a considerable addition in cargo space and a consequent increase in deadweight capacity. These vessels were designed for a deadweight of 3,500 tons, but have carried up to 3,990 tons. The *Anson S. Brooks* will carry up to 1,750 M feet of lumber and, with her oil tanks filled for fourteen days' steaming, will draw 21 feet of water. The principal dimensions of the vessel are as follows:

Length overall	286 feet
Beam, over planking	46 feet
Depth, molded	28 feet
Draft, loaded	21 feet
Indicated horsepower	1,400

Propulsion is by two vertical triple expansion engines with cylinders 15½ inches, 26 inches and 44 inches diameter by 26 inches stroke, which develop 700 indicated horsepower each. Steam is supplied by two standard Shipping Board type watertube boilers with a total heating surface of 5,036 square feet. The main condenser has a cooling surface of 2,002 square feet.

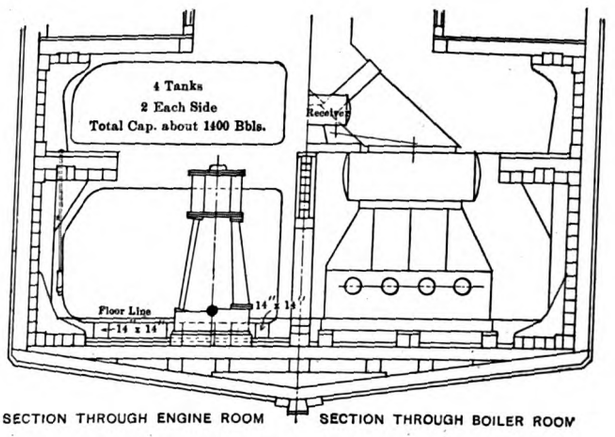

Fig. 2.—Sections Through Machinery Space

Provision is made for carrying 89 tons of fresh water and 1,440 barrels of fuel oil.

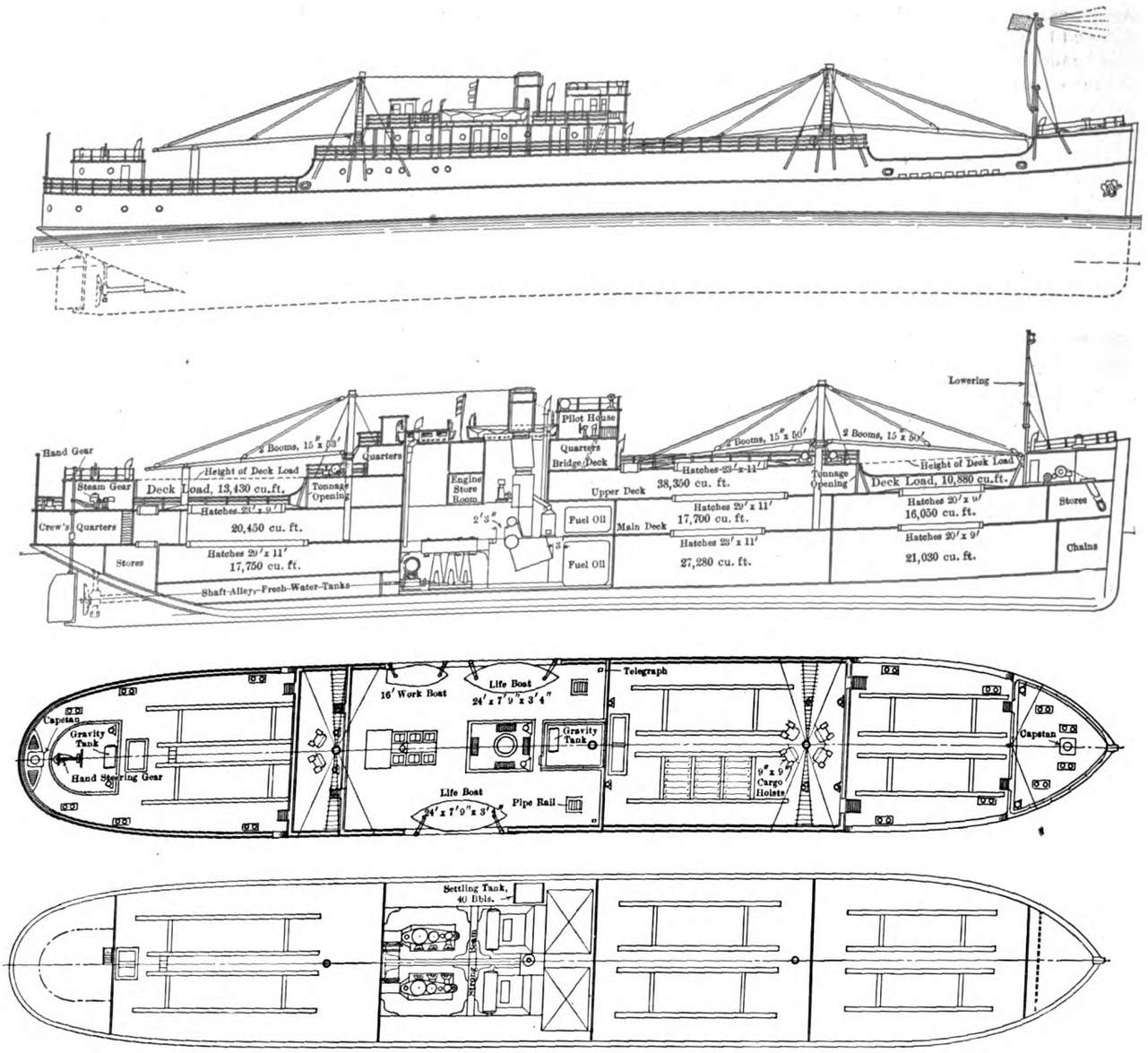

Fig. 1.—General Plans of Hough Type Wooden Lumber Steamer

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The cargo capacities of the various holds are as follows:

	Cubic Feet
No. 1 hold	21,030
No. 1 'tween decks	16,050
No. 2 hold	27,280
No. 2 'tween decks	17,700
No. 3 hold	17,750
No. 3 'tween decks	20,450
Upper 'tween decks	38,350
Deck load, forward	10,880
Deck load, aft	13,430
Total	182,920

The capacities given above are measured inside the line of the web frames. For bulk cargo the space between the web frames, amounting to 12,710 cubic feet, must be added, giving a total capacity of 195,630 cubic feet.

Electric Welding at Submarine Boat Yard

ELECTRIC welding is, as stated in a recent issue of *Speed Up* by W. L. Prince, superintendent of the welding department of the Submarine Boat Corporation, Newark, N. J., very essential in all great metal construction; and although it has long been in common use in other industries, its application to shipbuilding has been largely confined to repair work and to the welding of minor parts when failure would not be fatal to the safety of the ship. Its great worth having been proven, however, it is now used almost exclusively throughout the construction of the fabricated ships.

Early in February, 1918, the first electric welding machine was installed in the south shops for the purpose of welding water- and oil-tight frames. This, however, was but a beginning, for before a great length of time had expired between 500 and 600 operations were being performed by electric welding, and at the present time fifty-seven welding machines are in use throughout the plant.

The welding done now by acetylene is nothing in comparison to its usage formerly. Acetylene cutting is a great aid in the building of ships, as it enables the erectors and shipfitters to lay up the steel correctly, and all other workers as well. We have about eighty skilled mechanics who may be called upon at any time to either cut or weld.

Werf Gusto Launches 6,200-Ton Freighter

WERF GUSTO, Firma A. F. Smulders, Schiedam, Holland, launched on March 16 the steel cargo steamer *Ellewoutsdyk* for Messrs. Solleveld, van der Meer and T. H. van Hattum's Steamship Company at Rotterdam. This is the second of four vessels of the same type which Werf Gusto is building for this company.

The steamer, which is being built under special survey to the highest class of Lloyds as a lumber carrier, is of the single-deck type with poop, long bridge and forecastle, with a carrying capacity of about 6,200 tons deadweight. The dimensions are as follows:

Length between perpendiculars	359 feet 3 inches
Breadth, molded	50 feet
Depth	24 feet 6 inches

Propulsion is by a surface condensing, triple-expansion engine of 1,800 indicated horsepower, giving the ship a speed of about 10 knots, steam being supplied at a working pressure of 180 pounds per square inch by three Scotch boilers with a heating surface of about 5,450 square feet. The vessel will be fitted with an electric generating set for lighting purposes, a steam anchor and steering gear and the necessary steam-cargo winches.

Immediately after the launching, the keel was laid for a ship of the shelter-deck type of 6,500 tons deadweight destined for the same shipowners.

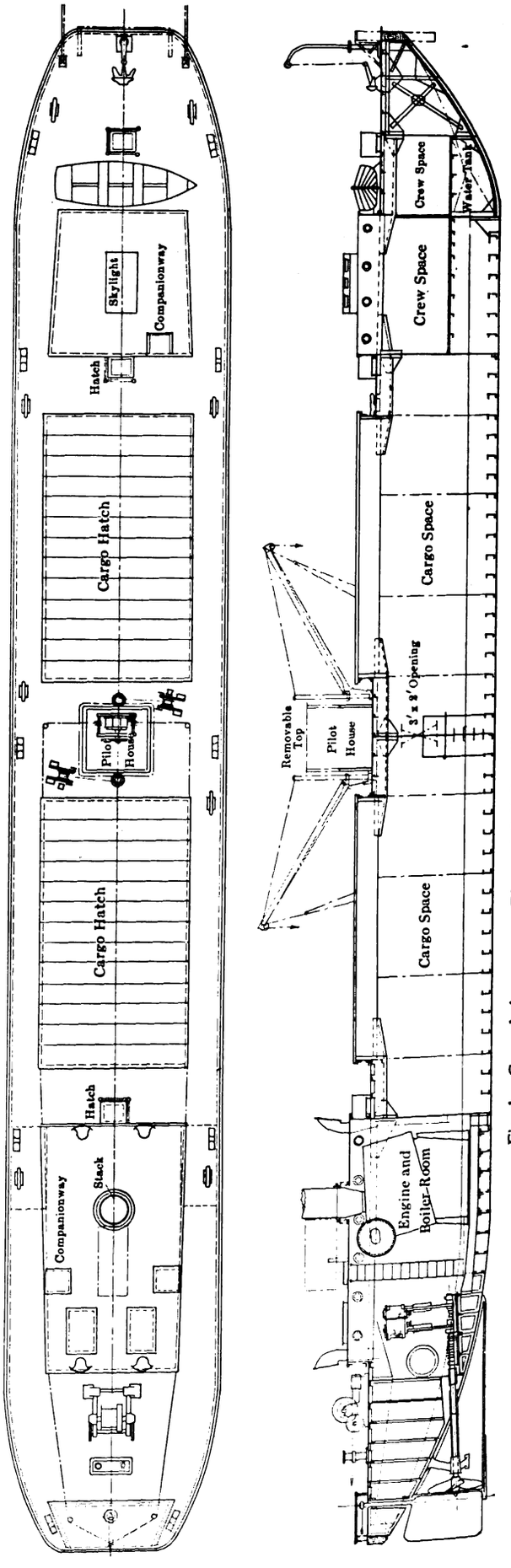

Fig. 1.—General Arrangement Plans of Self-Propelled Steel Barge for New York Barge Canal

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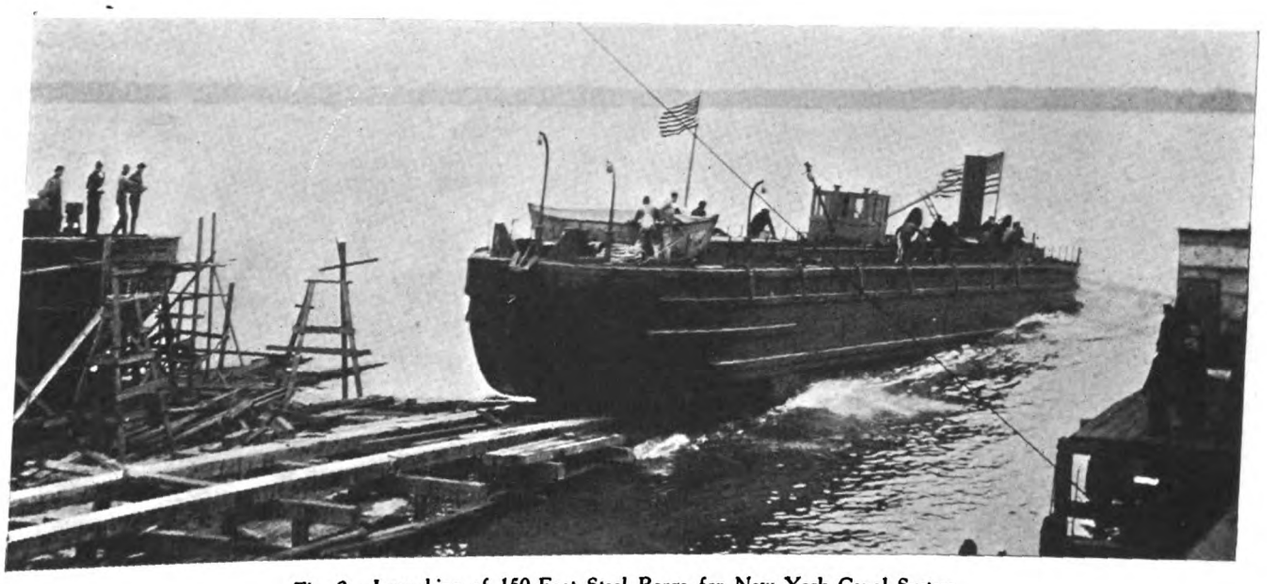

Fig. 2.—Launching of 150-Foot Steel Barge for New York Canal System

Steel Barges for the New York Barge Canal

Vessels 150 Feet Long Have Deadweight Cargo Carrying Capacity of 550 Tons—Contain Three Holds, Served by Large Hatches

FIFTY-ONE steel barges, each 150 feet long, designed by Cox and Stevens, naval architects, New York, are now under construction for service on the New York State Barge Canal. In addition to these, a number of similar barges with propelling machinery are being built, all of the barges being constructed under the supervision of Cox and Stevens, the designers.

The principal dimensions of the barges are as follows:

Length, inside fenders	150	feet
Beam, molded	20	feet
Depth	12	feet
Draft, light, forward	27½	feet
Draft, light, aft	30	feet
Displacement, light	155	tons
Displacement on 9-foot draft	705	tons
Deadweight cargo	550	tons

The hulls are square ended with rounded ends, as shown on plans. There is a slight shear at the ends to take up the camber of the beams. The bilge is cut away, as shown on the midship section.

The barges are divided into five compartments by four watertight transverse bulkheads, and have three cargo holds with two hatches for each hold. The ends are hung from the end bulkheads by lattice girders, as shown on plans.

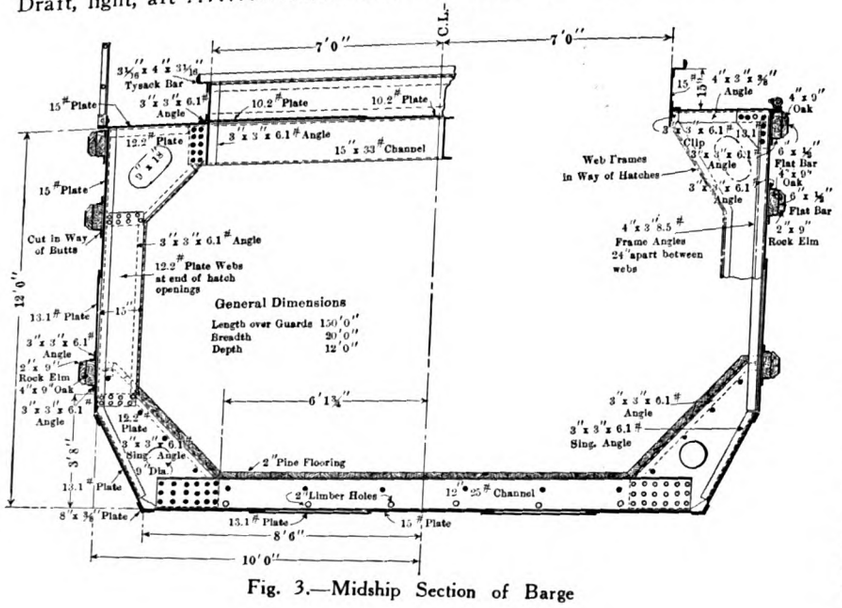

Fig. 3.—Midship Section of Barge

The accommodations for the crew are arranged for in a house at the after end of the barge. There is a skeg at the after end to which the rudder, operated by hand gear, is attached.

These barges are constructed throughout of steel, the details of the construction having been carefully developed so as to produce a light and serviceable hull. Especial attention is paid to the necessary protecting fenders, and the hull throughout is rigid and sufficiently strong to stand the usage to which these barges will be put.

The hatches, of which there are six in all, are as large as possible, being 14 feet wide by 10 feet in length, with coamings and tight covers. Ceiling of 2-inch pine is worked in the holds and carried up on the faces of the bilge brackets.

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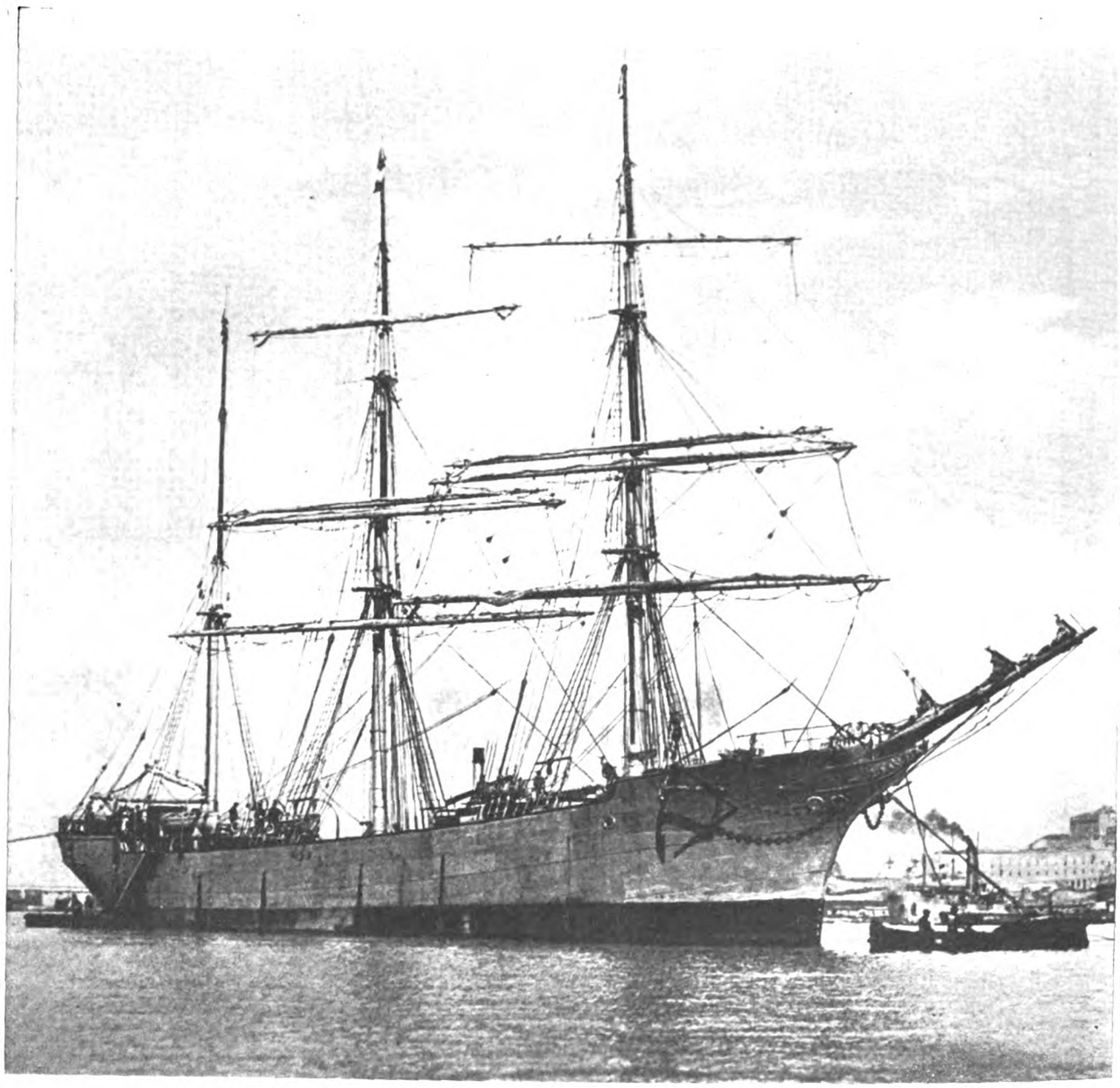

Fig. 1.—Auxiliary Schooner *Zilia*, 2,000 Deadweight Tons, Fitted with Tosi Diesel Engines

Diesel-Engined Auxiliary Schooners

Details of Propelling and Auxiliary Machinery Installed in Italian Sailing Vessel for Auxiliary Power

BY C. E. SPINNLER

DURING the war, owing to the acute shortage of tonnage, every available bottom was pressed into service. Especially was this true in European countries, which were hard hit and had to pay a very heavy toll to the submarines of the central powers; they were forced to make up their losses by putting into service old-fashioned sailing vessels, which in themselves were easy prey to the "sea-wolves" on account of their low speed and great visibility. To increase the speed of these sailing vessels and also to make them more independent of weather conditions, internal combustion engines were installed and are still now being placed in these hulls to great advantage, transforming the vessels into self-propelled cargo carriers.

In the beginning, many mistakes were made by putting incomplete and inadequate propelling machinery on board, or in other words underpowering the ship. These mistakes are gradually being eliminated, as practice has shown that a vessel for high-sea trade should have sufficient propelling power to give a speed of at least 8-9 knots in calm weather, or under all circumstances when sails cannot be used. I know of instances when 30-year old sailing vessels have made, with favorable wind, 16 to 17 knots for several days with sails alone.

In England, France and Italy old-steel sailing vessels have continually been so converted into auxiliaries. The English schooners *Circe Shell, Midway, Hornshell, Fennia* and *Oweenee* have, during 1918-1919, been provided

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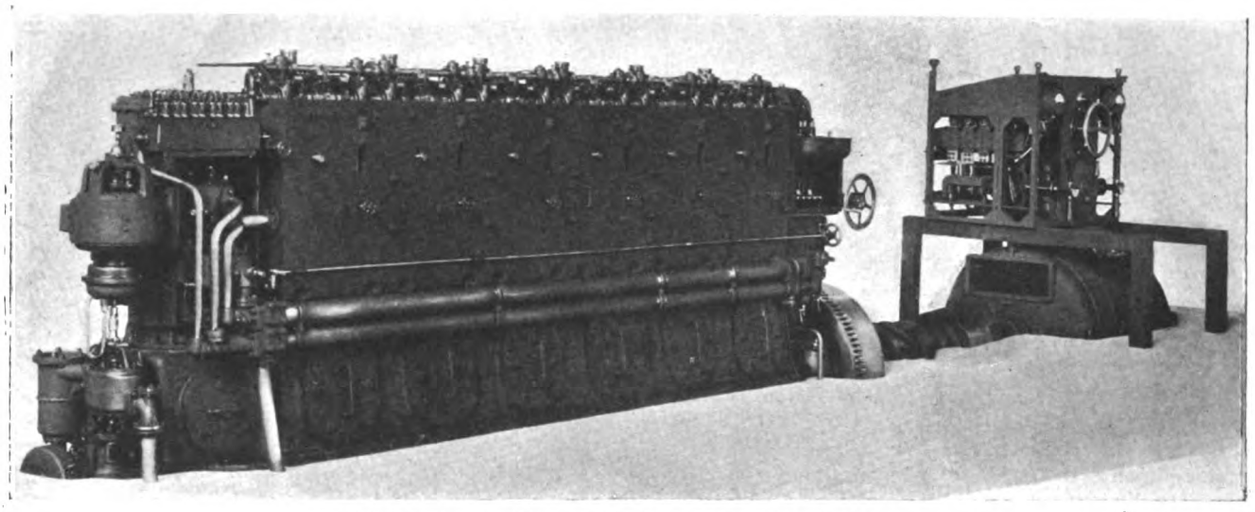

Fig. 6.—General View of Tosi Six-Cylinder Diesel Engine

with Vickers submarine engines of 1200-1300-horsepower, which give these vessels a speed of 9-9½ knots loaded. In Italy also, many good old-steel sailing vessels have been fitted with auxiliary power, to comply with a law passed by Parliament through the efforts of the Seamen's Association, which provides that no sailing vessel be allowed in high-sea trade which is not equipped with auxiliary propelling machinery. In Italy as well as in England, a great number of submarine engines have been and are still available, ranging in sizes from 300-horsepower per engine up to 1200-1300-horsepower.

Italian Auxiliary Sailing Vessel

The first Italian schooner provided with such an engine was the *A. S. Olona,* of the Lloyd Mediteraneo, Livorno. The engine on this boat is of the 2-cycle, 6-cylinder, 1300-horespower type. The rated horsepower as an auxiliary engine is 550 at a speed of 150 revolutions per minute. A second engine of the same type will be installed in another sailing vessel of the same company.

The success of such installations depends in no small degree upon how these engines are installed and, in the writer's estimation, very often insufficient consideration is given to the matter of a proper foundation for the engine itself and to the general arrangement of the main engine and auxiliaries. More careful study and greater consideration are required for the installation of such auxiliary engines on board existing sailing vessels than in new construction, and many mistakes, which apparently have been overlooked during the transformation, have in many instances unnecessarily burdened the owner with excessive expenditures for repairs, and also been the cause of the undermining of the reputation of the internal combustion engines as marine engines.

The latest additions to such converted sailing vessels are several Italian auxiliaries fitted with Tosi Diesel engines of the submarine type, as well as of the Crosshead type.

The sailing vessel *Zilia* of 2,000 deadweight tons, built in 1892, owned by the Soc. Stella d'Italia, of Genoa (see Fig. 1) has been converted to auxiliary power by the installation of two six-cylinder four-cycle Tosi trunk piston engines having cylinders with a diameter of 12-3/16 inches, and a stroke of 14¼ inches each, developing 250 horsepower each at 260 revolutions per minute. Each engine is connected to its propeller shaft by means of a friction clutch.

The dimensions of the vessel are:

Length	236 feet
Beam	34.2 feet
Depth	20.8 feet

From the plan (Fig. 3) it will be seen that the engines are installed right aft in the vessel. Each engine has a 3-stage injection air compressor placed at its forward end.

Starting Engine

These engines are directly reversible and are started by means of a small separate starting air engine, turning the flywheel by means of a spur gear, similar to the method used to start automobile and boat engines with electric starters.

Each starting engine consists of three single acting cylinders arranged around the crankshaft, each cylinder 120 degrees apart from the other (see Fig. 7), that it is

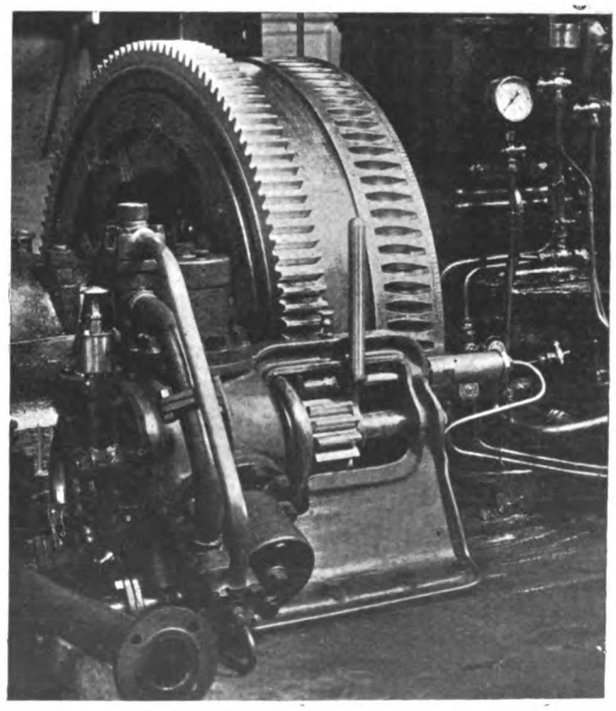

Fig. 7.—Air Starting Engine

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Fig. 8.—Italian Submarine, Fitted with Tosi Diesel Engines

possible to start the engine at any position. The starting engine pinion is drawn in and out from the flywheel gear automatically by an air control.

Machinery Arrangement

The arrangement of the pumps and other auxiliaries can be seen from the engine room layout (see Fig. 3). The engine room itself is roomy and well ventilated, and all the piping is so disposed as to permit a quick inspection and easy cleaning.

Each engine has four compressed air-storage steel flasks of a total capacity of 38 cubic feet air, at a pressure of about 1,000 to 1,200 pounds per square inch maximum. Their capacity is sufficient to start and reverse the engine for quite a number of times without recharging from the auxiliary compressor; during maneuvering, however, this little compressor is continuously in operation to keep the starting air pressure at the necessary height to insure quick air service. For the injection air one flask of 1.7 cubic feet capacity is provided for each engine with an air pressure of 1,000-1,200 pounds per square inch maximum. During operation a pressure of about 925 pounds per square inch is maintained.

The storage air flasks are arranged outboard of each engine, whereas the injection air bottles are fastened upside down to the aft mast and are provided with the necessary control valves. Each bottle is provided with a drain valve for water and oil.

All the bottles can be charged from either the main compressors or from the auxiliary compressor.

Fuel Oil Service

Each engine has its own service tank of a capacity of about 100 gallons. These tanks are provided with strainers, indicators and overflows and are fed by means of a fuel supply pump which pumps the fuel from the main tanks of these service tanks. From these tanks the fuel oil flows direct to the fuel injection pumps of each engine.

These fuel tanks are arranged as near as possible to the exhaust silencer at the aft end of the engine room on a gallery, so as to heat up the fuel oil to make it flow better through the piping to the fuel injection pumps.

A small light oil tank is also provided for each engine to start the engines more easily in cold weather.

Lubrication

Forced lubrication is provided for all parts of the engines such as crankshaft bearings, crank pins, and wrist pins.

The lubricating oil is sucked by the oil circulating pumps from the lubricating oil tanks, which are located in the bilge between the main engines, and driven through coolers from which it enters a header which runs inboard alongside of each engine. In connection with each crankshaft bearing a small feed line deviates from the header and in the usual way the oil is pressed through grooves in the bearings and holes in the crankshaft pins, webs and crankpins to the crankpin bearing and from here through the hollow connecting rod to the piston pin and bearing.

The oil is re-collected in the engine bilge and flows from here to the settling tanks which are of about 100-gallon capacity each. Each settling tank is provided with a double strainer and oil stand indicator. The strainers are easily removable for cleaning purposes during service.

The whole lubricating system is very well shown in the

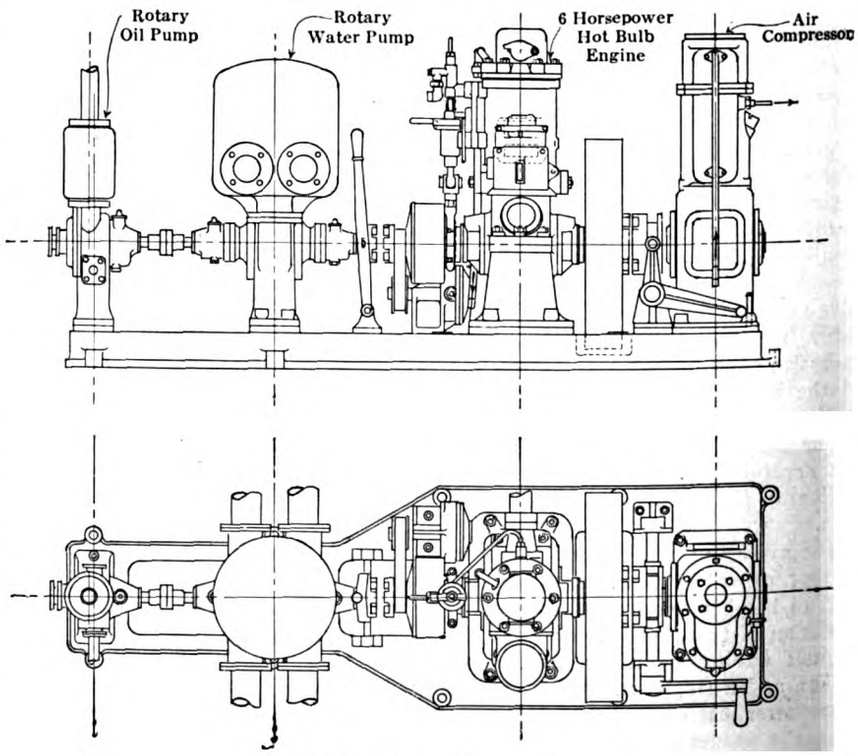

Fig. 9.—Tosi Auxiliary Set

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engine room layout, Fig. 3. Aft of the settling tanks a reserve lubricating oil tank is arranged, with capacity of about 125 gallons.

ENGINE ROOM AUXILIARIES

Among the auxiliaries there is a small combined compressor and pump set, composed of one 6-horsepower hot bulb oil engine running at 500 revolutions per minute, and driving on one side by means of a claw-clutch a 3-stage air compressor of suitable size to fill in a relatively short time the starting air and injection air bottles, at a pressure of 1,000-1,200 pounds per square inch. On the other side there is a group of one rotary auxiliary water pump and one rotary auxiliary oil-circulating pump. Both pumps are of sufficient size to supply the engine-cooling water and circulating oil for one engine, in case that the main pumps driven by the main engines should get out of order (see Fig. 9).

The guaranteed fuel consumption for these engines, combined with the auxiliaries, is 2.5 tons per 24 hours, and the lubricating oil consumption is also very low on account of the forced lubrication system used, amounting to about 3 grams per horsepower-hour.

All the main pumps, i. e., the water and oil-circulating pumps, are driven direct from the main engines. One set is large enough to supply the circulating water and oil for both engines at somewhat reduced speed.

From information received, the whole propelling machinery has given very satisfactory results and many other sailing vessels are being provided with similar power plants, varying in capacity from 500 to 750 and 1200-horsepower, at propeller speeds of from 260 to 165 revolutions per minute.

WEIGHT OF MACHINERY

The weight of the main engines, including the auxiliary set, air storage bottles, fuel oil and lubricating oil tanks and exhaust silencer, without, however, the friction clutch, thrust bearing and shaft lines, is about 36 tons or about 160 pounds per shaft horsepower. The whole installation, comprising engines, friction clutch, thrust bearing and shaft lines, should weigh no more than 50-55 tons, resulting in a weight of 220-245 pounds per shaft horsepower.

DECK AUXILIARIES

Several steam winches and a steam windlass have been placed on deck. A small oil-fired donkey boiler has been installed amidships on deck, the funnel of which can be seen on the photograph of the vessel shown in Fig. 1.

The writer has no information about the installation of an electric generating set, and it seems quite unbelievable that the installation of such a generating set has been omitted, as electric light on board ships is now-a-days quite as essential as fresh water.

Fig. 8 shows one of the smaller Italian submarines which have been built during the war, and which have been provided with engines of the same size and type as above described. From reports it appears that these engines have given complete satisfaction in actual service as regards both workmanship and performance.

Hudson River Steamboat Mary Powell

BY TOWNSEND J. SMITH*

It will be of interest to many to learn that the famous old Hudson River sidewheel steamer Mary Powell is finally to be sold to the ship-breaker, thereby ending a long career of usefulness. This vessel has been unique in that through a period of about fifty-five consecutive seasons of service, no serious accident ever occurred, and no passenger or member of the crew was ever killed.

BUILT at Jersey City, N. J., in 1861 by Michael Allison, the *Mary Powell* went into service in 1862, running on the Hudson River between Rondout and New York City, making about eight intermediate landings and doing the round trip daily, except Sundays, the distance totalling about 190 miles per diem. This in itself is no great feat, but to the native along the river's banks the discontinuance of the service will seem a real loss, as the boat had become an institution.

* Marine department, Standard Oil Company of New York.

Fig. 1.—S. S. *Mary Powell*, Famous Steamboat in Service on the Hudson River for 68 Years

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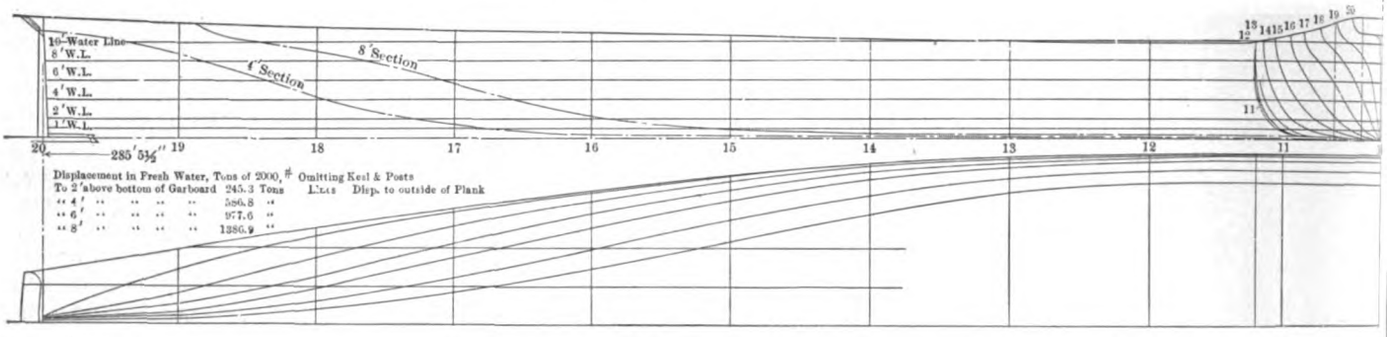
10' Water Line
8' W.L.
6' W.L.
4' W.L.
2' W.L.
1' W.L.
8' Section
4' Section
285' 5½"
Displacement in Fresh Water, Tons of 2000, # Omitting Keel & Posts
To 2' above bottom of Garboard 245.3 Tons
" 4' " " " " 586.8 "
" 6' " " " " 977.6 "
" 8' " " " " 1386.9 "

Fig. 2.—Waterlines and Body

Owing to changing river conditions, the present owners had come to feel that the boat's profitable days were over, but with a more than usual regard for sentiment had refused offers of various curio hunters who might have given the steamer an ignoble end, two of the conditions of the sale being that she was not to be burned, nor to be destroyed as part of a moving picture.

Built practically entirely from empirical design, data as to actual performance are lacking, except for the very ample figures supplied by the late chief engineer of the United States Navy, Admiral B. F. Isherwood, in the *Journal of the Franklin Institute* for July, 1879, from which some of the following facts are taken. The lines of the vessel, shown in Fig. 1, are authentic, having been drawn from offsets measured when the vessel was on dry dock in 1896. Structurally the vessel is of a type peculiar to the Hudson River, i. e., a shallow hull, kept in shape longitudinally by the "hog frame" truss construction of timbers about 12 inches by 14 inches, keyed together and extending from the keelson forward up through and over the joiner work decks, then down to the side keelsons at the after end, the sagging tendencies of the machinery weights being communicated to the truss timbers with vertical rods, diagonal rods leading to masts, one forward and four near the boilers, also being employed to distribute the strains.

The practice was to carry only enough coal for a day's run, or about 30 tons. The machinery with appurtenances, including water in the boiler, weighs about 210 tons, or with fuel about 27 percent of the load displacement. The boilers themselves were renewed at various times, the present ones having been built in 1904, but no change was made in the general design, which was of special tubular construction, with a superheating steam drum 90 inches diameter by 12 feet long, surrounding a chimney 50 inches diameter. The furnaces, two per boiler, measure 4 feet 9¾ inches by 8 feet long, giving a total of 154 square feet grate surface. The heating surface, estimated by Isherwood at 4,726 square feet, was later increased to 5,694 square feet.

These boilers are mounted on the guards (sponsons), the theory of the early builders being that a disaster was less likely to be serious if the boilers went overboard, rather than up through the deck, should an explosion occur.

The propelling machinery, built by Fletcher, Harrison & Company, predecessors of the present W. & A. Fletcher Company, Hoboken, N. J., is of relatively simple construction, the engine being of the single-cylinder, jet-condensing, walking-beam type, "the beam being supported upon a lofty triangular gallows frame of wood, very stiff and very light." The cylinder is of 72 inches diameter by 144 inches stroke, developing, in the trial referred to, 1,745 indicated horsepower at a consumption of 21.93 pounds of steam per hour, exclusive of steam used by the forced draft engine. Allowing 5 percent as the blower consumption of steam, 40,171 pounds of steam per hour were used and 6,050 pounds of anthracite coal, giving a water rate of 6.64 pounds of water per pound of coal and 39.3 pounds of coal per square foot of grate.

The air pump is of the vertical, single-acting type, 40 inches diameter by 62 inches stroke. The main cylinders and steam pipes from the boilers are heavily lagged with asbestos, but the valve chests, side pipes and cylinder heads are not lagged.

The two admission valves are set to cut off at about 48.6 percent of the stroke, the exhaust valve closing at 23.2 percent from the end of the stroke for cushioning effect. The lineal clearance of the piston is about 1⅝ inches.

The paddle wheels were never fitted with feathering floats, the old style of flat "buckets" being maintained to the end. The main particulars of the wheels were as follows:

Outside diameter	31 feet
Number of buckets per wheel	26
Revolutions per minute	21.8

At the time of the trial in 1877, when the boat was probably in what might be called average age and condition, the following were the results obtained as a mean of regular runs:

Expansion in cylinder	1.984
Temperature of injection water	68 degrees F.
Temperature of hot well	120 degrees F.
Air pressure in fan duct	1¼ inches
Steam pressure at commencement of stroke	41.4 pounds
Mean pressure	24.42 pounds
Speed in statute miles per hour	19.2
Speed in knots (of 6,080 feet) per hour	16.657
Apparent slip (center of pressure)	16.37 percent
Speed length ratio	.98

The fastest times actually on record for the steamer were made in 1882, when 25 miles were covered in one hour and one minute, and another in 1893, when the distance from New York to West Point, or 50 miles, was covered in two hours and five minutes.

Taken all in all, the whole life of this boat has been a success, and goes to show that the teachings of the rule of thumb and experience such as guided the building of this boat are never to be despised, especially in the realm of things maritime.

COEFFICIENTS OF LOAD WATERLINE IN TERMS OF BREADTHS—STEAMBOAT *MARY POWELL* (See Fig. 2)

Stem	.02	6	.99
½	.11	7	.91
1	.23	8	.66
2	.50	9	.29
3	.78	9½	.13
4	.96	Stern	.02
5	1.00		

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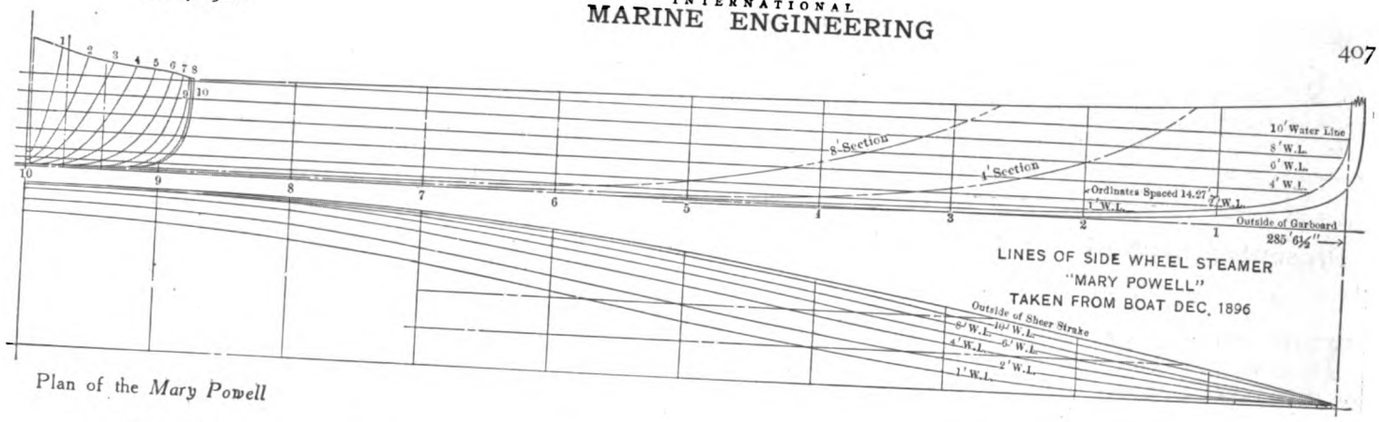


Plan of the *Mary Powell*

Destroyers and Submarines Built by Swan, Hunter, and Wigham Richardson, Ltd.

FOLLOWING the programme of the British Admiralty to relieve private yards of warship construction and to give more work to the dockyards, H. M. S. *Whitehall*, a torpedo boat destroyer, has just left the Wallsend Shipyard of Messrs. Swan, Hunter, and Wigham Richardson, in an incomplete state. The ship is to be propelled by two screws driven by turbines built by The Parsons Marine Steam Turbine Company, Ltd., of Wallsend. The main engines, auxiliaries, piping, etc., have all been put on board, but final connections are not yet made. The bridge deckhouses are erected but not entirely finished, and the interior woodwork has still to be fitted. In the same way, the officers' quarters aft have not yet received their final embellishments. The ship's guns and torpedo tubes will also be installed by dockyard hands.

The *Whitehall* is the thirtieth destroyer built by Messrs. Swan, Hunter and Wigham Richardson, since the outbreak of the war. Her predecessors were H. M. S. *Wild Swan* and *Whitshed*, which are similar to the *"V"* class of destroyers which were commissioned two or three years ago. Of the latter class the *Vimiera*, *Violent* and *Victoria*, followed by the *Whirlwind* and *Wrestler*, were built at the Wallsend shipyard. After these destroyers came the *"S"* class of which Messrs. Swan, Hunter and Wigham Richardson launched seven in 1918. These were followed by the improved *"W"* class of which examples are the *Whitshed*, *Wild Swan* and *Whitehall*. They carry more torpedo tubes and heavier guns than those of the earlier *"V"* and *"W"* class destroyers. Furthermore, the navigating bridge has been raised and various other modifications have been introduced.

The British Navy has also just received another useful addition in the shape of the submarine *L*.33, built and engined by Messrs. Swan, Hunter and Wigham Richardson, of Wallsend-on-Tyne. Before leaving the Tyne, the *L*.33 went through a series of trials both on the surface and submerged, which were carried out satisfactorily.

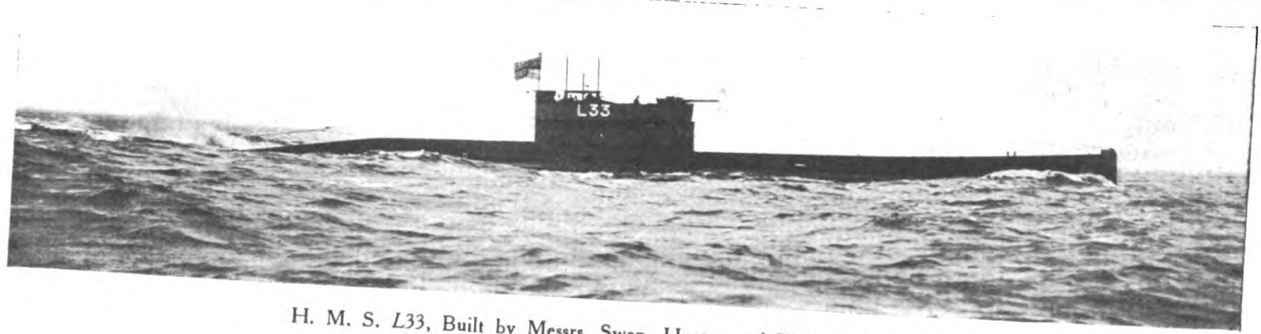
The class of submarine to which the *L*.33 belongs has been shown to be about the most useful and efficient for all-round ocean-going service. She shows marked improvements upon preceding ships, one of the most noticeable to an outside observer being the position of her gun, which is placed on a revolving platform on the conning tower instead of being fitted as in earlier ships on the forward deck, which is too low a position to work a gun easily except in comparatively fair weather.

In addition to her gun, *L*.33 has a battery of torpedoes which make her a most formidable craft. She is propelled on the surface by a twin set of internal combustion oil engines built at the Neptune Works of Swan, Hunter and Wigham Richardson. When submerged the ship is, of course, driven by electric motors, supplied with current from storage batteries.

In every part of the ship the latest machinery and apparatus known in submarine service have been installed. These are chiefly noticeable in the central control room, which is more spacious than is often found in submarines, and has been admirably planned to ensure the efficient and prompt working of the ship in action and at all times. A gyroscopic compass is installed, connected with several tell-tale cards placed in convenient positions. There are three periscopes of the latest pattern, fitted in the ship. A telescopic mast immediately abaft of the periscope carries the aerials for wireless telegraphy. The receiving and transmitting cabin is within the central control room, and in it are connections with the ship's hydrophones.

The ventilation of the ship has been very carefully studied, air trunks being led through every compartment. Electric fans in connection with these trunks ensure air being kept as fresh as possible in the dynamo and engine rooms as well as in the torpedo room and in other compartments of the ship, where there is accommodation for sleeping and messing. All cooking on board is done by electric ovens and hot plates.

The forward hatch of the ship gives access to the officers' quarters, which are handsomely panelled in



H. M. S. *L*33, Built by Messrs. Swan, Hunter and Wigham Richardson

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polished mahogany. There is a most comfortable ward-room with sleeping quarters alongside. Between the ward-room and the central control room excellent living accommodation is provided for the petty officers and the crew.

Present Status of the Concrete Ship*

BY H. C. TURNER†

THE original concrete-ship program of the Emergency Fleet Corporation called for the construction of thirty-eight 7,500-ton vessels, three 3,500-ton vessels and one 3,000-ton vessel, making a total of 42 vessels. Immediately after the armistice, this program was reduced to eight 7,500-ton tankers, two 7,500-ton cargo vessels, three 3,500-ton cargo vessels and one 3,000-ton cargo vessel, or a total of 14 vessels. In October, 1919, the two 7,500-ton cargo vessels were canceled, leaving twelve vessels to be completed.

At this date, all of the four small cargo vessels are in service. They are the *Atlantus,* 3,000 tons deadweight, and the *Polias, Cape Fear* and *Sapona,* each of 3,500 tons deadweight. Of the 7,500-ton tankers, three have been launched, the *Palo Alto* at San Francisco and the *Selma* and *Latham* at Mobile. The remaining five tankers are in various stages of completion. It is expected that all will be in commission before June 1.

In addition to these vessels, twenty-one 500-ton canal barges were built by the Railroad Administration under the supervision of the Emergency Fleet Corporation. All of these barges are in service with the exception of one which was sunk in the Hudson river in the early part of December.

Construction Problems Successfully Met

In general, it may be said that in carrying out the concrete ship program, no construction problems have been encountered that have not been successfully met. The original design of the 7,500-ton tankers has been modified to some extent, owing to the discovery of undesirable high stresses in some of the members under test and service conditions. While the revisions contemplated involved concrete construction, seldom, if ever before, attempted, it is believed that the changes will remedy the undesirable conditions. The experience of the vessels in service thus far indicates that, so far as the cargo vessels are concerned, there is ample structural strength, and the barge is a much simpler problem.

The hope that reinforced concrete would provide a material from which hulls could be built with much greater speed than is possible in the case of steel has not been realized. The average time of constructing the concrete hull has been seven months. Outfitting and equipping the hull has taken on an average between three and four months. Undoubtedly, with the experience gained, this time could be materially bettered.

Service Records

The experience with the ships in service thus far indicates that they are great sea boats.‡ In every case of which there is record, these ships have behaved admirably in heavy weather, and have won considerable praise from officers and crews. There is generally very much less vibration in concrete ships than in corresponding steel ships. There is also a very considerable increase in the period of roll, which is quite desirable. The increase in the period of roll is undoubtedly due to the fact that these vessels have a relatively large moment of inertia around a longitudinal axis even when loaded with cargo. This is due to the mass of the concrete shell, which is considerably greater than the mass of the shell in a steel ship. In none of the vessels in service has any leakage whatever been reported. A few shear cracks are noticeable in the shell and bulkheads in all the ships in service, but these cracks are unimportant and have no apparent effect upon the structural strength of the ship.

One characteristic of the concrete vessels built by the Emergency Fleet Corporation should be noted in this connection. Experience seems to indicate that these vessels are unable successfully to withstand severe concentrated blows on the shell without the shattering of the concrete. Impact which, in the case of the steel ship, would probably only cause indentation to the plates, in the case of the concrete ship is apt to cause a shattering of the concrete over the area adjacent to the point of impact. A number of instances of injury of this kind have been observed, particularly in the case of the barges constructed by the Railroad Administration. In the case of nearly every barge the shell has been injured in one way or another, requiring repairs to the concrete. It has been found, however, that repairs are relatively simple and can be effected with little loss of time and at almost negligible cost. The barges in question have very little protection in the form of fenders. It is believed that where adequate fenders are provided, so that there is chance for the absorption of the work of a blow by means of some resilient material, such as an oak fender, this objectionable feature of the concrete barge may be obviated.

Deadweight Capacity Less Than Figured

The figures noted above for the deadweight capacity of the several ships constructed by the Emergency Fleet Corporation are the nominal deadweight capacities contemplated by the design. In no case has the nominal deadweight capacity of the ship been realized. The average deadweight capacity of the 7,500-ton tankers will be in the neighborhood of 6,800 tons. In the case of the *Atlantus,* nominally having a capacity of 3,000 tons, the actual deadweight capacity is 2,542 tons; the *Cape Fear* and *Sapona* nominally 3,500 tons, have deadweight capacities of 3,078 tons; the *Polias,* nominally 3,500 tons, built of heavy gravel concrete, has a deadweight capacity of 2,460 tons. It was expected that the ratio of deadweight capacity to displacement would run from 0.55 to 0.60. The actual ratio of deadweight to displacement will average but little more than 0.50.

In making a comparison between the relative carrying capacities of steel and concrete ships, one important consideration should be kept in mind. Taking into consideration a steel ship and concrete ship, each having the same deadweight capacities, the concrete ship—because of the greater weight of the ship itself—must have greater dimensions than the steel ship, and in consequence, must have greater hold spaces. For heavy weight cargoes, such as steel, coal or oil, in which the deadweight capacity is reached before the hold spaces are filled, it is apparent that steel has an advantage over concrete as a material of construction, assuming that the construction and operating costs are equal. For bulky cargoes, such as ordinary package goods, cotton, fruit or other materials for which the space required exceeds about 70 cubic feet to the ton, the

* Abstract of report read before the American Concrete Institute, Chicago, February, 1920.
† Chairman of committee on reinforced concrete barges and ships.
‡ The *Polias* went ashore on the Maine coast near Penobscot Bay on February 6.

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concrete ship will actually carry more deadweight than the steel ship for the reason that the hold spaces of the steel ship will be filled before the deadweight capacity is reached.

The cost of the small cargo vessels, leaving out of consideration the *Atlantus*, which was the first vessel built, varies from $210 to $300 per deadweight ton. The cost of the 7,500-ton tankers will vary between $200 and $250 per deadweight ton. These figures are based upon the nominal deadweight carrying capacity rather than the actual. These costs naturally include certain experimental work and other expenditures which could be reduced on future work, so that the above experience is not a sufficient basis on which to forecast the costs under peace conditions and skillful management.

CONCLUSIONS

No definite conclusions should be drawn as yet from the experiences of these vessels. It should be borne in mind that all the vessels were under construction at approximately the same time and that there was little chance to profit by experience. When it is remembered that these were the first vessels ever attempted of this size, the showing is not discouraging. The only general conclusion that may be drawn from the experience of the ships constructed under the direction of the Emergency Fleet Corporation seems to be that it is possible to construct ships of concrete in about the same time and for approximately the same cost as the corresponding steel ships. This indicates that, after there has been more experience in the art, it will be possible to reduce both the cost and the time for construction.

There remains only the question of length of life of concrete ships. Only time can safely answer this question, although it should be stated that the brief experience of the *Faith* and the Emergency Fleet vessels has disclosed no serious inherent weakness to shorten the life of the concrete ship.

Barges and canal boats, in order to have a commercial future, must apparently overcome two objections—first, a reduction in cost as compared with wood, and this may come through experience in design and construction; and, second, the development of a method to offset the damage sustained to the hull from slight collisions with tugs or other boats or in docking.

Another Diesel Electric Installation

CONSIDERABLE interest was aroused by the description appearing in the March issue of this magazine of the auxiliary schooner *Elfay*, which was the first Diesel electric drive installation on record. Since publishing the description of *Elfay's* remarkable power plant, Mr. Russel A. Alger, her owner, has made a trip of over 8,000 miles without having any trouble whatsoever with either the Diesel engine itself or with the electrical equipment.

As a direct result of the very satisfactory and efficient service rendered by the Winton Diesel electric drive equipment in the *Elfay*, Mr. Edgar Palmer has decided to equip his new boat with the same type of propulsion.

This new vessel will not only be the largest Diesel yacht ever built in this country, but also is the largest fore and aft auxiliary schooner yacht ever built in the world. This beautiful boat was designed by A. Loring Swasey, and the system of Diesel electric drive was worked out by him with suggestions from Commander Fisher, of the United States Navy.

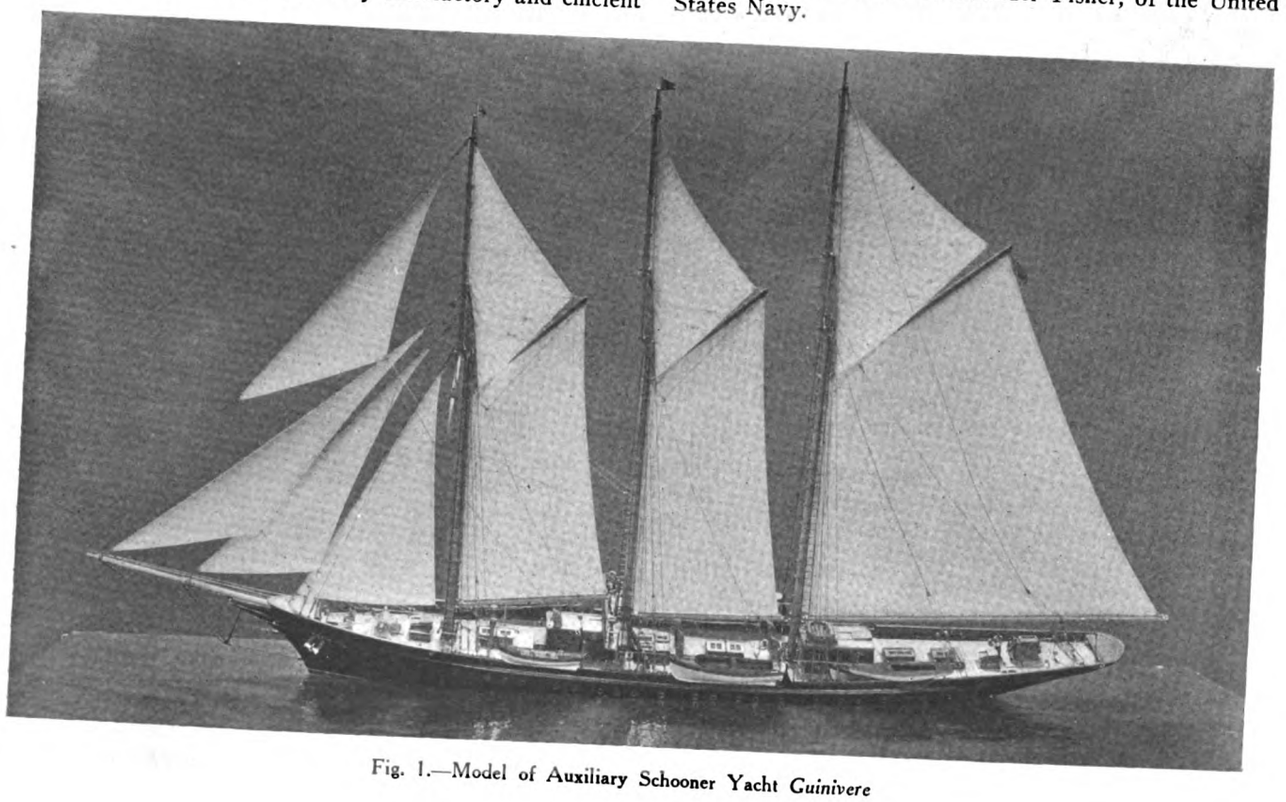

Fig. 1.—Model of Auxiliary Schooner Yacht *Guinivere*

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Mr. Palmer's yacht carries a pair of Winton Diesel engines direct connected to generators which operate a driving motor, which in turn operates a large Bevis patent propeller. This gives the Diesel electric drive a better opportunity than was given it in the *Elfay*, as Mr. Palmer's boat can be run on one engine at slightly reduced speed and on both, if full speed is desired, giving a great factor of safety in case repairs have to be done to one of the units while underway.

To give an illustration of the great possibilities of this outfit as it will be installed in Mr. Palmer's new boat, which will be named *Guinivere*, after his other boat, it is of interest to compare the new boat with the old, as they are approximately of the same size.

Fig. 2.—Stern View of Model of the *Guinivere*

The old vessel had a Scotch boiler with quadruple expansion steam engine. With this outfit she carried 160 tons of coal and had a cruising radius of 4,000 miles. The new vessel carries 95 tons of oil and has a cruising radius of 11,000 miles. Moreover the engine room force will be reduced by six men, which today is quite an item of expense. The Diesel electric drive installation also allows of a much more roomy cabin arrangement below decks, giving more spacious living accommodations and a very much larger capacity for stores, etc.

With the new *Guinivere* there is no necessity for a smokestack, which is always a great bugbear on an auxiliary schooner; this type of installation also makes it possible to give one entire extra deck house. The exhaust is absolutely clean, running out of the after end of the boat under the surface of the water.

With the Winton Engine Works and the Westinghouse Electric and Manufacturing Company constructing the power plant, and with George Lawley & Son Corporation building the hull, this boat should be the finest possible example of what undoubtedly is a new era of ship propulsion, and is bound to revolutionize not only the powering of all large yachts, but will be a tremendous factor in working out true economy in the merchant fleets of this country.

Details of the New Yacht

The principal dimensions of the new *Guinivere* are as follows: Length overall, 195 feet; length on waterline, 150 feet; beam, molded, 32 feet 5 inches; draft, 15 feet; displacement, 642 tons; speed under power, 11½ knots; propeller, two-bladed, 8 feet 4 inches in diameter.

The vessel was designed by A. Loring Swasey, and is under construction at the yards of George Lawley & Son Corporation, Neponset, Mass. The power plant consists of a pair of 6-cylinder 350-horsepower model 24-A Winton Diesel oil engines, with a bore of 13 inches and a stroke of 18 inches, operating at 225 revolutions per minute. Each engine is direct connected to a 225-kilowatt, 125-volt Westinghouse shunt wound generator, each in turn operating by chain drive a 15-kilowatt, 125-volt direct current compound wound Westinghouse exciter turning at 1,150 revolutions per minute. This plant supplies electric power to the 555-horsepower, 250-volt Westinghouse motor operating at 220 revolutions per minute and located in the stern.

The auxiliary equipment consists of a 2-ton Clothel ice machine, a pair of 15-kilowatt generators for auxiliary work, each of which is operated by a 25-horsepower Quayle engine. All other auxiliary equipment throughout the boat, such as bilge pumps, fire pumps, service pumps, ventilating fans, hoists, both anchor and sail, wireless set, etc., are operated by electric power, no steam being used or required on the boat.

The installation of this power plant has been worked out under the active supervision of Mr. Alexander Winton, of the Winton Engine Works, and Mr. Wilfred Sykes, of the Westinghouse Electric and Manufacturing Company.

Operation of the Machinery

One of the interesting features of the installation is that the generators will be not only ringed oiled, as is the usual practice, but provision is also made for flooding them with oil from the oil system of the Winton Diesel engines. This provision is made so that they will operate satisfactorily no matter what the list of the ship may be.

The driving motor will be enclosed at its forward end and will have an inlet at the top of this end for the entrance of the cooling air. Centrifugal fans direct connected to a 1¾-horsepower motor will furnish approximately 3,500 cubic feet per minute of air for the ventilation of this motor.

The method of operation for this drive is practically the same as used in the auxiliary schooner yacht *Elfay*. For normal operation at full power the two main generators are connected in series furnishing power to the motor. The generators and motor are arranged for separate excitation at 125 volts on the exciter circuit. The speed of the motor from zero to maximum in either direction is controlled by means of the reversing rheostat which controls the excitation of both generators, thus controlling the generator voltage and therefore the speed of the motor. This arrangement makes it possible to operate the ship at almost any speed desired up to the maximum ahead or astern. It also allows for reversing without interrupting the main circuit.

Unlike the *Elfay*, the *Guinivere's* power plant will be

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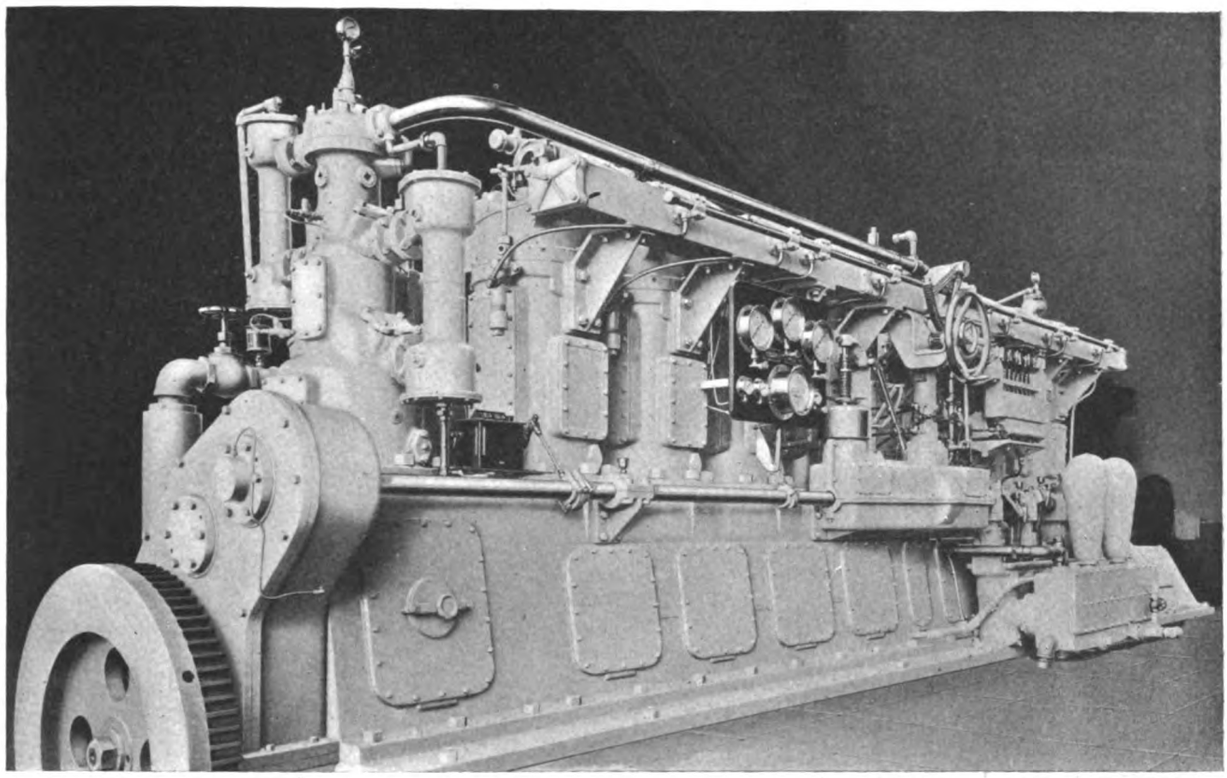

Fig. 3.—View of Six-Cylinder Winton Diesel Oil Engine Installed in the *Guinivere*. Bore, 13 Inches; Stroke, 18 Inches

controlled from the engine room by signals from the pilot house. The reversing rheostat will be mounted at the rear of the main switchboard panel, and will be operated by a hand wheel suitably marked on the front of the panel board. In addition to the reversing rheostat this panel will carry an automatic circuit breaker for overload production, meters, knife switches for generator and motor field circuit, a two-pole double throw knife switch for each main generator armature circuit. By means of the latter switches, each generator may be connected in series with the other generator or disconnected, leaving the other generator connected to the motor. This arrangement makes it possible to operate at reduced speed when one generator is shut down or when it is desired to operate the ship at low speed for a considerable time. Each of these switches will have extra terminals to allow for connection to the anchor windlass motor switch on the auxiliary control panel in case of the necessity of using power over and above that supplied by the auxiliary generating units.

The Westinghouse Geared Turbine

DECLARING that the geared turbine is beyond the experimental stage, Norris R. Sibley, in a talk before the recent meeting of the Ocean Association of Marine Engineers, held in New York City, brought out various salient considerations explaining the reasons why the marine geared turbine has proved its superiority over the reciprocating engine.

Mr. Sibley, who is connected with the marine department of the Westinghouse Electric & Manufacturing Company, stated that there are over 100 ships in active service equipped with the geared turbines made by his company. A number of these ships have been in commission for over two years, and several have records of over 100,000 miles.

He attributed the increasing use of the marine geared turbine to three main reasons, as follows:

1. It is economical in fuel consumption because it is able to operate with a very high vacuum. This makes it more efficient than the reciprocating engine and enables it to take a vessel over a given voyage with from 10 to 25 percent less fuel.

2. Greater cargo space is secured, as the geared turbine is smaller and lighter than the reciprocating engine of the same horsepower.

3. The turbine, being simpler in construction, is easier to operate and keep in condition.

The speaker then explained, with the aid of stereopticon views, steps in the manufacture of turbines, reduction gears, condensers, pumps, propeller shafts and other apparatus manufactured at the new Westinghouse plant in South Philadelphia along the Delaware river.

New Plant Required

He stated that prior to 1918 the marine turbines had been made at the East Pittsburgh plant, but that, because of the increased volume of this class of business, it was decided to erect a plant exclusively for the manufacture of this apparatus. The new plant, which is of thoroughly modern construction, has a floor area of 7 acres and gives employment to 5,000 workers.

One of the reasons advanced by the speaker why the turbine has gained so much popularity is the establishment of schools by the recruiting service of the Shipping Board, which give instruction in turbine practice. These schools are located at the plants of the turbine manufacturers. Chief engineers and first assistants, who are handling or expect assignments to turbine-equipped ships, are sent to these schools, with shore pay, traveling and sustenance allowances. Here they obtain practical instruction in the operation, erection, care and repair of turbines, gears, condensers, electrical machinery and auxiliaries.

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Fig. 1.—New Fitting-Out Crane at Philadelphia Navy Yard

The Largest Fitting-Out Crane in America

350-Ton, Hammer-Head Crane Erected on Fitting-Out Pier of League Island Navy Yard—Built by McMyler-Interstate Company

(Photographs by Edwin Levick, New York)

THE largest crane of its type in America, with a lifting capacity of more than a million pounds, has been completed and put in operation at the League Island Navy Yard, Philadelphia. The crane is located on the recently constructed 1,000-foot fitting-out pier at the yard, and its completion represents a definite step in engineering progress.

An idea of the size may be had from the fact that a ten-story building could be placed under the jib of the crane and that its overall height is over 245 feet, or about that of a 17- or 18-story building. The cost of the entire crane structure above the foundations was approximately $875,000 (£180,000), and of the foundations $120,000 (£24,600).

Tests of the new crane, in the course of which it was loaded to 125 percent of rated capacity and operated in all cycles of duty, have recently been concluded. The largest single load in these tests was 980,000 pounds. The most spectacular of these tests was the lifting of a total load of 1,010,000 pounds—a locomotive weighing 100,000 pounds on the auxiliary (50-ton) hoist, a load of steel billets weighing 416,000 pounds on each of the main (175-ton) hoists, and a locomotive weighing 78,000 pounds on the machinery house crane.

The maximum capacities, 50 gross tons for the auxiliary hoist and 350 gross tons for the main hoist, were determined in conjunction with the Bureaus of Construction and Repair and Steam Engineering as ones that would permit turrets, guns, etc., to be completely assembled (except for armor plating) in the shops at the Navy Yard and transferred to the ships on barges or cars and placed on board the vessels intact, eliminating the operations of dismantling and subsequently reassembling on board ship usually necessary, with a consequent marked increase in economy of time and money in the construction of capital ships. The large weight-handling capacity will also make the crane of inestimable value in the performance of major repairs to vessels.

The location of the crane at the waists of the ships berthed on either side of the pier will permit the placing of most of the heavy weights without moving or turning the ships. The placing of minor parts, which forms the greater proportion of the work of fitting out a ship, will be rapidly and economically done by two auxiliary, small capacity (5 to 10 tons), quick-acting cranes of the same general type, but with a traveling instead of a fixed tower, and smaller height and reach, which will be installed to operate along the pier on each side of the main crane.

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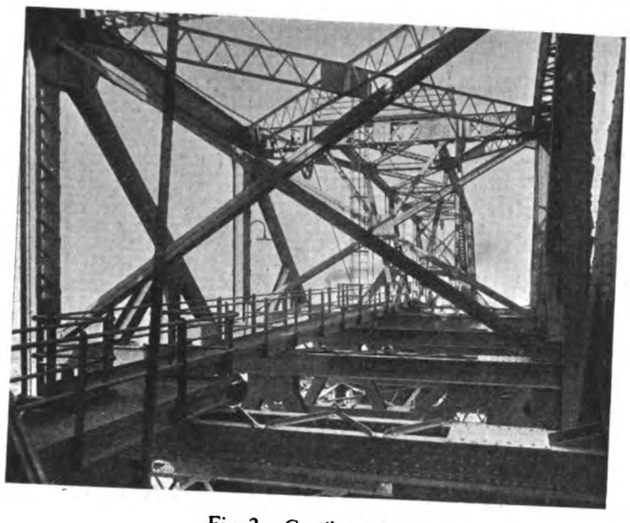

Fig. 2.—Cantilever Jib

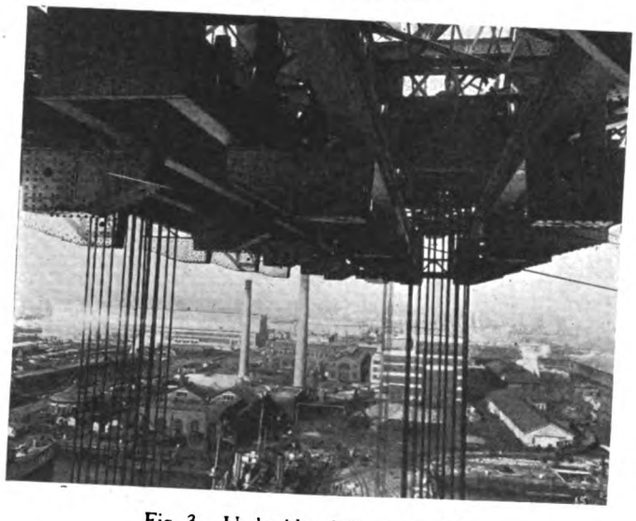

Fig. 3.—Underside of Cantilever Jib

Fig. 4.—Main and Auxiliary Hoists

In some cases it is contemplated that these cranes may also be supplemented by floating derricks where it is desirable to expedite the construction by placing medium weights beyond the reach of the pier cranes without moving the ship.

General Description of Crane

The crane, as designed and constructed, consists of a fixed portal 56 feet square, supporting on deep girders an octagonal tower about 56 feet wide at the bottom and

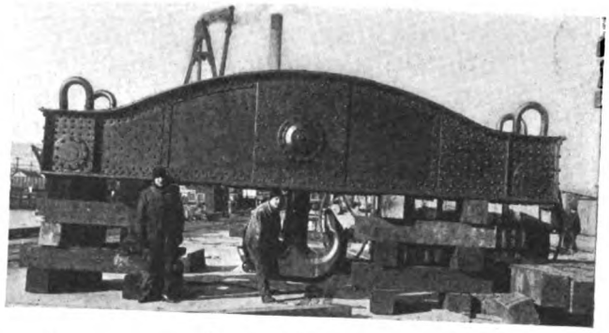

Fig. 5.—Main Hook

Fig. 6.—Fixed Portal and Base of Tower

tapering to a bearing pintle 5 feet in diameter at a height of approximately 201 feet above the deck of the pier. Supported vertically on this bearing pintle and revolving thereon is a horizontal cantilever jib or boom 300 feet long over all, to which is readily attached a "petticoat" which envelops the fixed tower from the bottom of the jib down to a height just above the portal. The entire vertical load from the hoists is transmitted to the tower at the pintle, mentiond above, but lateral thrusts are taken into the fixed tower at the pintle and into the circular girder at the base of the octagonal tower by the circular girder which forms the rim of the "petticoat."

The forward cantilever of the jib contains the three runways for the trolleys that carry the loads. The rear cantilever of the jib carries the counterweight and the house containing the machinery and drums for hoisting and lowering loads and racking the trolleys in and out on the forward cantilever. The machinery for revolving the jib is located at the level of the top portal girder and the rotating impulse is transmitted through the rim of the "petticoat."

This enveloping "petticoat" provides a greater than usual factor of safety against failure by overturning of

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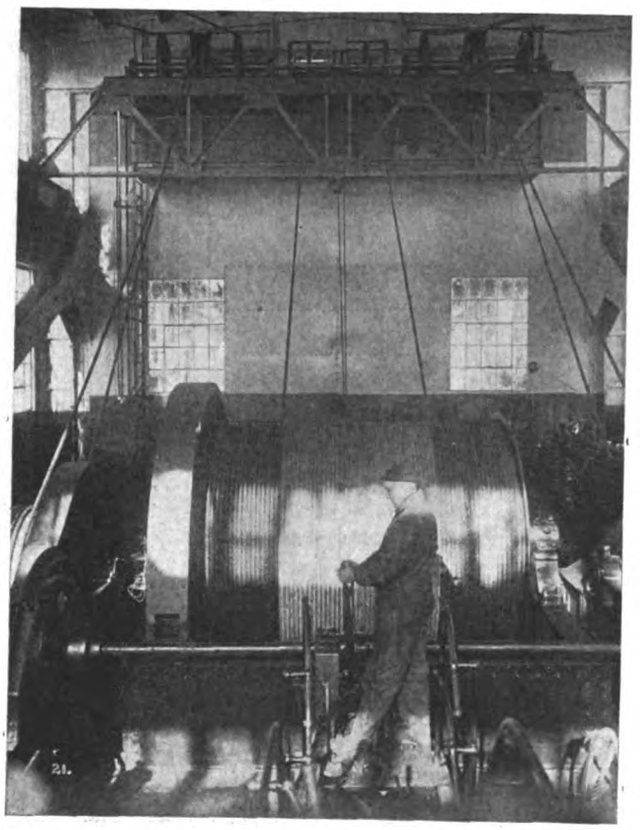

Fig. 7.—Main Hoisting Drum

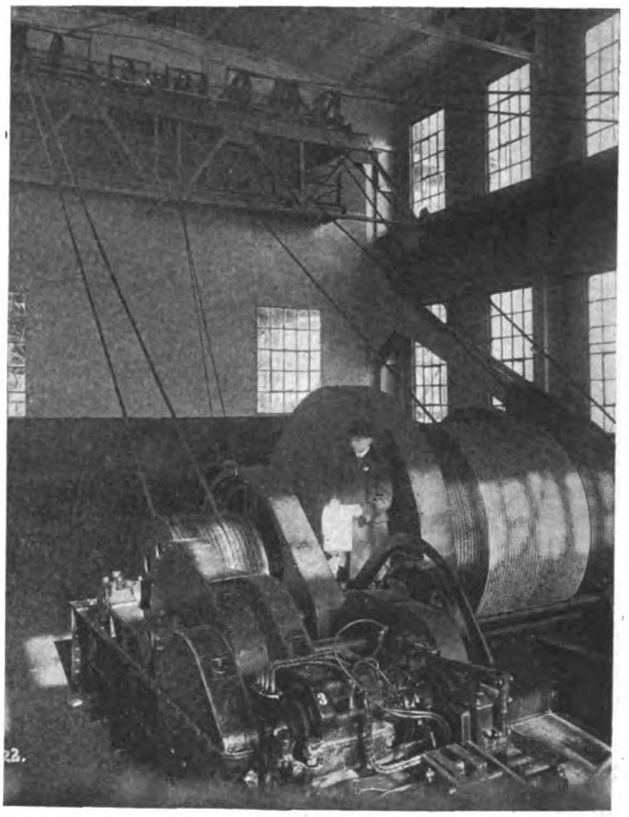

Fig. 8.—Main Hoisting Motors

the jib, in the event of excessive accidental overload of crane, than would be given by the other and more usual design under consideration by the Bureau, in which the jib is simply supported by the tower on a circular bearing similar to that of a swing bridge or a turntable. The entire framework of the crane is of structural steel of bridge grade and the entire operation is by means of electricity.

Access to the jib machinery house, etc., is provided by

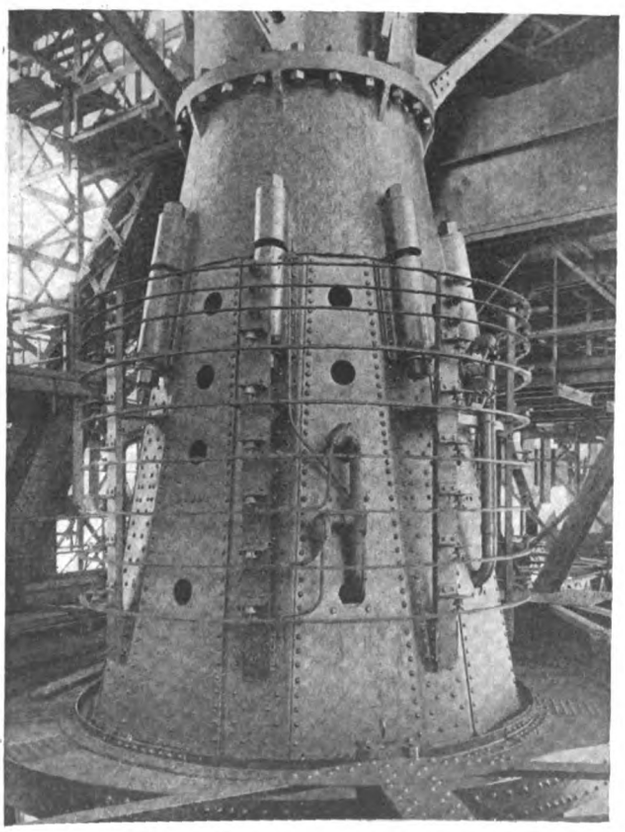

Fig. 9.—Revolving Head of Tower

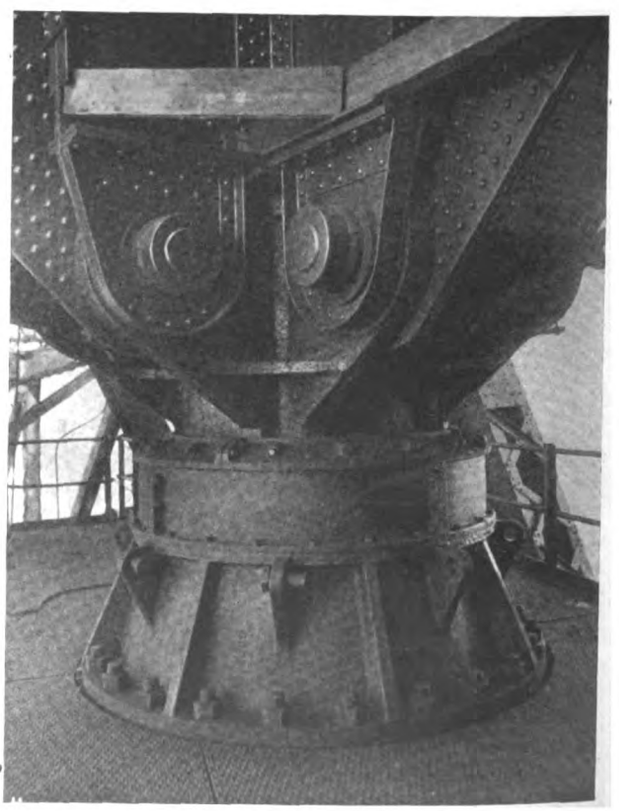

Fig. 10.—Main Pintle

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means of a steel stairway in the tower and an electrical elevator mounted on the outside of the "petticoat" and the jib.

DETAILS

The forged steel hooks by which the loads are raised have, in the case of the 175-ton hook, a shank 9 inches in diameter and, in the case of the 350-ton hook, a shank 13 inches in diameter. The 50-ton block and load are carried by eight 1⅜-inch wire ropes; the 175-ton block and load by sixteen 1⅝-inch wire ropes running on 50-inch pulleys, and the 350-ton block and load by thirty-two 1⅝-inch wire ropes. The 350-ton block is carried from the two 175-ton blocks by a steel equalizing beam 4 feet 10½ inches deep.

The clear lift of the main hook is 141 feet above and 29 feet below the deck of the pier, and of the auxiliary hoist 151 feet above and 29 feet below. The three trolleys carrying loads in and out on the forward cantilever of the jib operate on separate runways, the one 50-ton trolley to a distance of 190 feet from the center of the tower and the two 175-ton trolleys to a distance of 115 feet from the center of the tower. The two 175-ton trolleys are arranged so that they can be coupled together in order to lift, by means of the additional hook and equalizing beam above mentioned, the capacity load of the hoist, 350 gross tons or 392 short tons.

The forward cantilever is 200 feet long, 40 feet wide from the tower to the limit of travel of the main hoists,

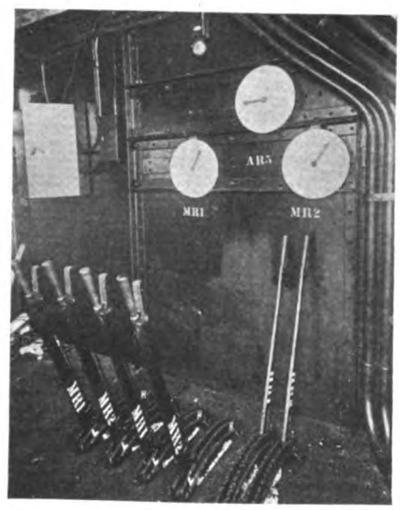

Fig. 11.—Levers for Operating Clutches

and 13 feet 4 inches beyond that. Its trusses have a depth of 40 feet at the tower.

The rear trusses, carrying the machinery house and the counterweight, are 100 feet long and 20 feet deep and form a cantilever 40 feet wide.

The machinery house itself is a large building—80 feet long, 43 feet wide and 32 feet high—and contains the machinery for hoisting and lowering the hooks and for racking the trolleys. The two main hoisting motors and the one auxiliary hoisting engine are of 87 horsepower each; the two main racking motors and the one auxiliary racking motor are 27½ horsepower each. The drums on which the ropes for the main hoist are wound are 10 feet in diameter and 14 feet long and revolve on a drum shaft 10½ inches in diameter.

The machinery house also carries an overhead traveling crane of the bridge type of 35 tons capacity (determined by the weight of the main drum and drum shaft) for the handling of machinery. The runway on which this crane operates extends through the rear wall of the machinery house a distance of 17 feet. By lowering the rear wall of the house, which is especially designed for the purpose, the crane is permitted to travel out beyond the end of the building in order to transfer parts to and from the pier, about 215 feet below.

The counterweight is of concrete and weighs 628,000 pounds.

The pintle supporting the rotating part of the structure (the jib and "petticoat") is of cast steel, 60½ inches in

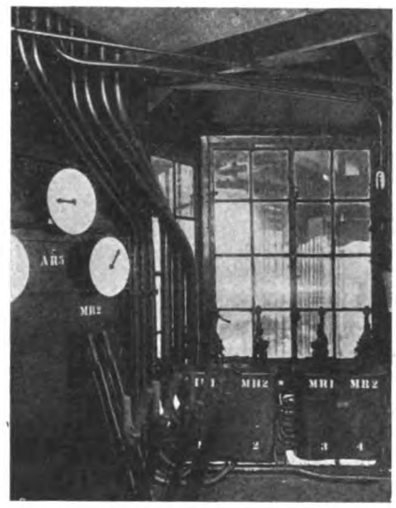

Fig. 12.—Controllers

diameter, and when the crane is loaded to rated capacity carries a vertical load of 5,834,000 pounds and takes a lateral thrust due to maximum conditions of wind, loading and eccentricity of 607,000 pounds. The vertical load is taken by means of 220 roller bearings 3 inches in diameter and the horizontal thrust by 62 rollers 2 inches in diameter. The metal of the bearing rollers is a high carbon, high chromium tool steel with the exceptional ultimate bearing strength of 290,000 pounds per square inch after hardening treatment (raised from 96,000 pounds per square inch before treatment).

The eccentricity mentioned is due to the fact that the jib is designed so that the overturning moment, or tendency of the jib to overturn, is equal and opposite in direction under each of the two conditions of no loading and maximum rated load; in case of no load on the crane, the center of gravity of the rotating mass is 12.45 feet behind that of the tower, and in the case of maximum load 10.65 feet in front of that of the tower. This tendency toward overturning is resisted by the horizontal bearing of the bottom rim of the "petticoat" on the circular girder encircling the tower legs, as well as by the horizontal bearing at the pintle, and in the case of that due to vertical loads, is neutralized at the top of the portal girder. The horizontal thrust at the bottom rim of the "petticoat" is taken up by means of sixty-four 26-inch wheels mounted on two chains and bearing on a circular girder 55 inches deep and 64 feet in diameter.

The slewing or revolving mechanism located at the top of the portal consists of an 87-horsepower motor with gearing, driving four pinions working in a rack 64 feet in diameter, having 768 teeth of 3.1416-inch pitch and 12-inch face.

The operating speeds of the crane are as follows:

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Hoisting—
Main hoist, 2½ feet per minute.
Auxiliary hoist, 15 feet per minute.

Racking—
Main trolley, 15 feet per minute.
Auxiliary trolley, 80 feet per minute.

Revolving—One complete revolution in 12 minutes.

All of the operations of the crane are controlled from an operator's cab located under the jib adjacent to the tower and in full view of all of the handling operations of the crane. The machinery is controlled from the cab by means of master controllers operating solenoid switches located in the machinery house. Clutches for throwing the hoists into high or low gear and for coupling together the main hoists when using the equalizer beam are located in the machinery house and are mechanically operated by levers in the operator's cab.

The structure is designed so that when it becomes necessary to renew pintle bearings or make repairs the entire rotating structure (the jib and "petticoat") can be jacked up from the portal by means of four 30-inch jacks of 560 tons capacity each.

The portal has four legs, spaced 56 feet center to center, each of a sectional area of 385 square inches of structural steel, supporting the massive girders 9 feet deep, which carry the octagonal tower. The maximum load on one of these legs was computed at 3,000,000 pounds under maximum conditions of wind pressure, and for this load the legs and the foundations were designed. The portal has a clear height of 25 feet 7 inches, which provides ample clearance for locomotive cranes or other equipment on the two tracks passing through it. A power substation which furnishes the electrical current for the operation of the crane is also located beneath the portal.

The entire deadweight of the crane structure is calculated at 4,000 tons. An uplift of 59,000 pounds being possible in any one leg due to maximum wind loads on the structure, four bolts 3 inches in diameter are used to anchor each leg to the foundations.

Each of the four tower legs is supported on grillages 10 feet 4 inches square, made up of two layers of rolled steel girders embedded in massive reinforced concrete caps 35 feet 4 inches square and 9 feet 6 inches deep, tied securely together longitudinally and transversely by the deep reinforced concrete girders of the pier deck. Each of these caps rests on 156 timber piles driven to the hard cemented gravel river bottom and cut off at water level. These piles are supported laterally by an earth fill inclosed and retained by reinforced concrete sheet piles jetted and driven into the hard river bottom. Most of these sheet piles are 18 inches by 24 inches in section and 52 feet long. They weigh about 12 tons, are tongued and grooved to interlock one with another to form a reinforced concrete wall around the entire foundation 24 inches thick, and spanning from caps and lateral connecting girders to the river bottom.

The crane structure was designed by the McMyler-Interstate Company of Bedford, Ohio, under the general supervision and in accordance with the specifications of the Bureau of Yards and Docks, Navy Department, and was erected by that company under the supervision of the Public Works officer at the Navy Yard. The contract for the crane was awarded to the McMyler-Interstate Company in January, 1918, and the erection was begun in April, 1919, and completed in December, 1919.

The foundations were designed by the Bureau of Yards and Docks and constructed by the Snare and Triest Company of New York City as a part of the 1,000-foot by 100-foot fitting-out pier. This construction was also under the general supervision of the Public Works officer of the Navy Yard.

Merits of Corrugated Bulkheads

A PAPER read before the Northeast Coast Institution of Engineers and Shipbuilders by Archibald Hogg on "A Test of Watertight Bulkheads for Ship Subdivision" gave rise to an interesting discussion, in the course of which the corrugated bulkhead advocated by the author was the subject of considerable criticism. The two most important disadvantages of the corrugated bulkhead were stated to be the extra cost and the reduction of stowage capacity which its adoption would entail. "To both of these points Mr. Hogg was able to give a satisfactory reply," says a report of the discussion. "With regard to cost, it was pointed out that the steel saved per bulkhead, say ten tons, was all in the form of stiffeners and brackets on which the labor saved, which included riveting, amounted to about £35. Against this had to be charged the cost of rolling 18 plates and of setting four bars for the curved plate bulkhead, totalling about £10 to £15. With steel at present prices the total saved ought to be well over £100 per bulkhead. On the question of stowage in way of curve-plated bulkheads, the author suggested that inspection of an actual bulkhead with its wide shallow curves would satisfy those who raised the point that the stowage was at least as good as that obtainable with the many stiffeners and brackets of the flat bulkhead. The curve-plated bulkhead did not add to the bale-carrying capacity, he said, though it added about 100 cubic feet to the grain capacity by the volume of steel saved."

Lighting Sets of the S. S. St. Paul

THE S. S. *St. Paul*, of the American Line, which turned over in her slip two years ago, has been reconditioned and has resumed her passenger service between New York and Southampton. Her rehabilitation is a splendid example of American achievement, and henceforth her passengers will enjoy even greater comfort and service than they were accustomed to in the old days.

Apart from the fact that the accident had rendered the old lighting set on the vessel practically worthless, it was necessary to install units that would satisfactorily meet the increased power demand caused by the addition of several new electrical conveniences. In order to do this, five Westinghouse engine generator units of 35 kilowatts each were requisitioned. These are located just forward of the engine room, and each consists of a vertical 9-inch by 8-inch single-cylinder Sturtevant engine, operating at 400 revolutions per minute, with steam at 125 pounds pressure, condensing into a 26-inch vacuum. This engine is coupled to and mounted on a common base with a Westinghouse direct-current, 125-volt, 400 revolutions per minute generator, with non-corrosive parts and impregnated coils to afford protection against moisture. The five units may be operated individually or in parallel, according to the load demand.

In addition to lighting the ship these sets supply power for the elevator, stateroom heaters and radio set, and also an electric dishwasher, a dough mixer, potato peeler, toasters, plates and smoke-room boiler.

As will be observed, electricity plays a large part in the comfort and efficiency of this ship; and although the *St. Paul* has plied the Atlantic for many years, she is still in condition to hold her own as a first-class passenger ship.

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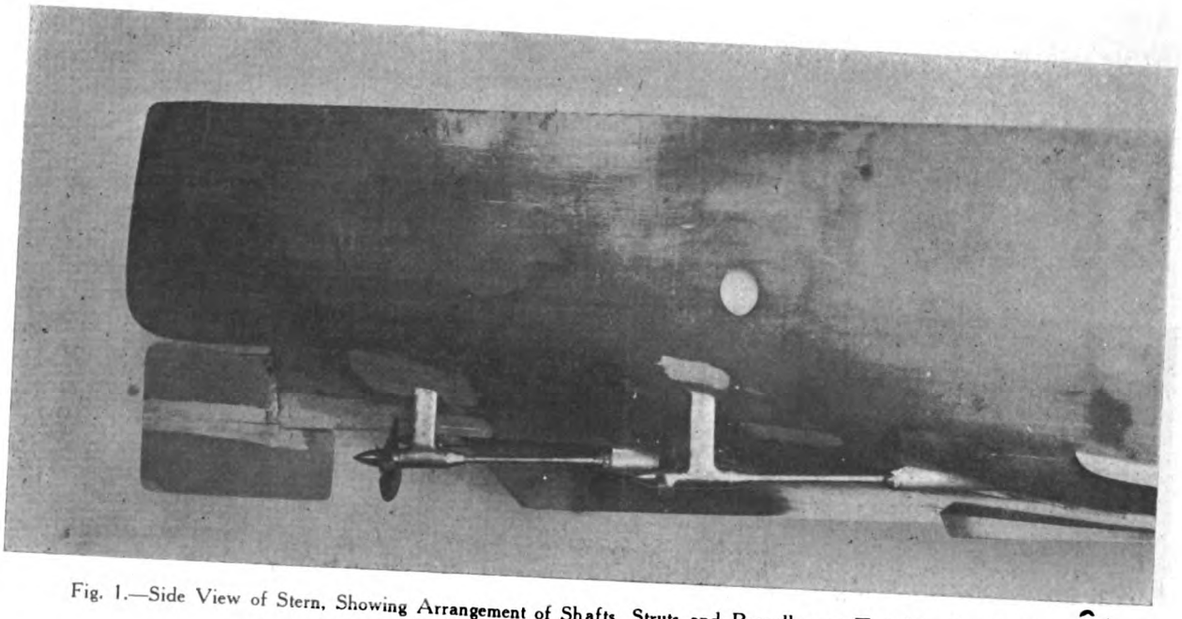

Fig. 1.—Side View of Stern, Showing Arrangement of Shafts, Struts and Propellers as Tested in the Model Basin

Estimates of Propeller Performance from Self-Propelled Model Tests

BY COMMANDER WILLIAM MC ENTEE, CONSTRUCTION CORPS, U. S. N.

DURING the last four years there has been developed at the Experimental Model Basin at the Washington Navy Yard an interesting and valuable method of testing the models of ships with the propellers in place and actually propelling the model. Sufficient experience has been had to indicate that the method is capable of giving very accurate results. It also has been of much value to the Bureau of Steam Engineering in supplying an independent check on propellers designed by Dyson's well-known method. The subject should, therefore, be of interest to naval architects and marine engineers who in the estimate of power requirements for new ships must take two important steps in the design of a ship and its propelling machinery:

(1) The selection of suitable lines for minimum resistance and the estimate of the effective horsepower required at different speeds.

(2) The selection of a suitable propeller so that the power of the machinery may be applied to the propulsion of the ship most effectively.

When there is a happy solution of both requirements (Nos. 1 and 2), the resulting design is one which is economical in both fuel used and in weight of the machinery installation.

As regards the determination of the form of the hull, experience in the use of Froude's law of comparison in testing models in model tanks in different countries has amply demonstrated its accuracy. It is in fact the only satisfactory method of estimating the effective horsepower required for a ship when its lines differ in a material degree from those of previous models and ships tested. Moreover, there has been a large amount of experimental data made public with regard to the factors affecting a ship's resistance, so that with intelligent application of the same a fairly close estimate may be made for ships of normal type.

When it comes to the design of a propeller to use on a particular ship, there is inherently a more difficult problem to solve. The performance of a propeller alone, even when running in free undisturbed water, is dependent on so many variables that it is a very complex subject. When to these complexities of the propeller alone are added those due to the form of the ship's hull itself, it is readily seen that there is greater need for an accurate model-testing method for estimating power requirements for a given combination of hull and propeller than there is for estimating the performance of either by itself.

For the propeller alone, the experimental field has been well covered in the researches of Froude in England and Taylor and Durand in this country, as well as by those of other investigators in Germany and elsewhere. These experiments have served to clear up to a large extent the haze which until comparatively recently seemed to surround the conceptions of propeller action. In fact, the experimental data derived by these investigations have served to discredit many mathematical theories of the propeller, so that at the present day, so far as the writer is aware, there is not a single rigidly rational propeller theory which fully explains the observed phenomena or which may be used with certainty to predict the performance of a new type of propeller.

It may be considered, then, that the information available as to the lines of ships' hulls and the performance of propellers of conventional form in free water are sufficient for all ordinary purposes. It is when seeking to estimate the effect of combining a certain propeller with a certain hull that there are introduced elements of doubt which may lead to important errors in estimates of shaft horsepower or revolutions of the propeller.

Recognizing this difficulty, Rear Admiral Dyson has developed a method of design which is based on the trial results of actual ships. The estimates obtained by his

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method are entirely satisfactory when the ship and propeller fall in the range of variables covered by existing trial data. It is apparent that, with the almost unlimited number of possible variables in form of hulls and propellers, it will require many years and the trials of many ships before it becomes of universal applicability.

There is, therefore, a real necessity for a method of testing models of the hull and propeller running together. Experimental work of this kind has been done by Froude and Luke in England, but their published results are limited to statements of certain factors, such as wake and thrust deduction coefficients resulting from certain combinations of hull and propeller. There are no data available to show how close the agreement between the performance of the full-size ship and those estimated from the model tests is. The arrangement of the test apparatus used by them is open to the criticism that it does not completely fulfill the requirement of similarity between ship and model, as the propeller is not carried by a shaft extending from inside the model, but by a separate shaft wholly outside of it and supported by separate attachment to the towing carriage.

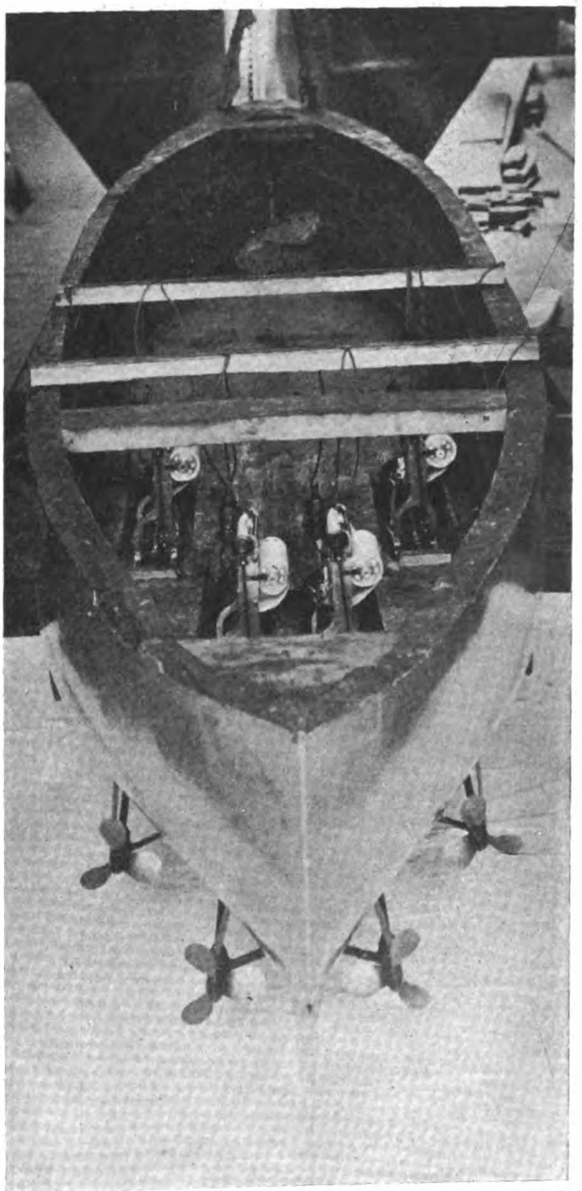

Fig. 2.—Stern View, Showing Shafts, Struts, Propellers and Dynamometers in Model as Tested in the Model Basin

The following is a description of the method as developed and used at the Washington Model Basin with comparative results of model tests and ship trials for the U. S. S. *New Mexico*.

The model to one-thirtieth scale was fitted with all appendages and with shafts, struts and propellers to scale in accordance with plans of the ship and machinery as built. The appearance of the model fitted with propellers is shown in Figs. 1 and 2.

In making the tests each shaft was driven by a small direct-current motor coupled directly to the shaft. Each motor was arranged as a dynamometer with calibrated springs which permitted simultaneous measurement of torque, revolutions per minute and thrust on each shaft, while the model was self-propelled under the Model Basin towing carriage. The model was arranged so that the towing carriage would steer it in a straight course while running at a uniform predetermined speed. The model was free to gain or lose a distance of about six inches as compared with the towing carriage before it would strike stops. During the course of each run the speed of the propellers was adjusted so that the model was running under its own power at a speed just equal to that of the towing carriage. When the model was running uniformly, so as not to strike either stop, cards recording the revolutions per minute, thrust and torque on each shaft were taken simultaneously. The speed of the model was taken by a card on the towing carriage in the same manner as when making model resistance experiments. A sample dynamometer card is shown in Fig. 4.

The results of the experiment are shown in Fig. 3 and in the following table.

TABLE I.—COMPARISON OF SHIP TRIAL DATA (U. S. S. *NEW MEXICO*) WITH MODEL TEST RESULTS

Speed of Ship on Trial, Knots	Revolutions per Minute		Shaft Horsepower		
	From Model Test	On Ship Trial	From Model Test	Ship Trial, Torsion Meter	Ship Trial, Electric
9.92	77.95	77.93	2,915	3,144	2,948
14.91	114.50	114.89	8,818	9,021	9,073
16.84	131.10	131.38	13,285	13,481	13,919
18.95	148.00	148.94	19,600	20,662	21,403
20.68	163.60	163.45	27,130	27,292	29,082
21.31	170.00	170.27	31,230	31,357	33,722

An examination of the table and Fig. 3 will show that the revolutions per minute, as estimated from the model tests, agree remarkably well with the revolutions per minute as determined on the ship's trials, the difference being less than ½ of 1 percent, except at the speed of 18.95 knots, at which there is a difference of nearly one revolution. The shaft horsepower as estimated from the model also agrees very well with that obtained on the trial of the ship, excepting that at the same speed, where the difference is about 1,000 shaft horsepower, or 5 percent. In Fig. 3 it will be noted that the slope of the power curve at the higher speeds as determined from electrical measurement agrees very well with the slope of the power curve estimated from the model experiments. The electric power given is from the observed electric input to the motors on the standardization trials of the ship corrected for the estimated motor losses, so as to give the estimated net shaft horsepower delivered by the propelling motors at the motor couplings. This power is about 8 percent higher than that given by the torsion meters and as estimated from the Model Basin tests. This appears to be a larger difference than would be expected to be accounted for by the thrust and other bearing losses which are not included in the model test results or in the torsion meters on the ship trials.

From this comparison, and considering also the results obtained on the trials of a sister ship, the U. S. S. *Idaho*, it is believed that the trial data on the ship's trials at the

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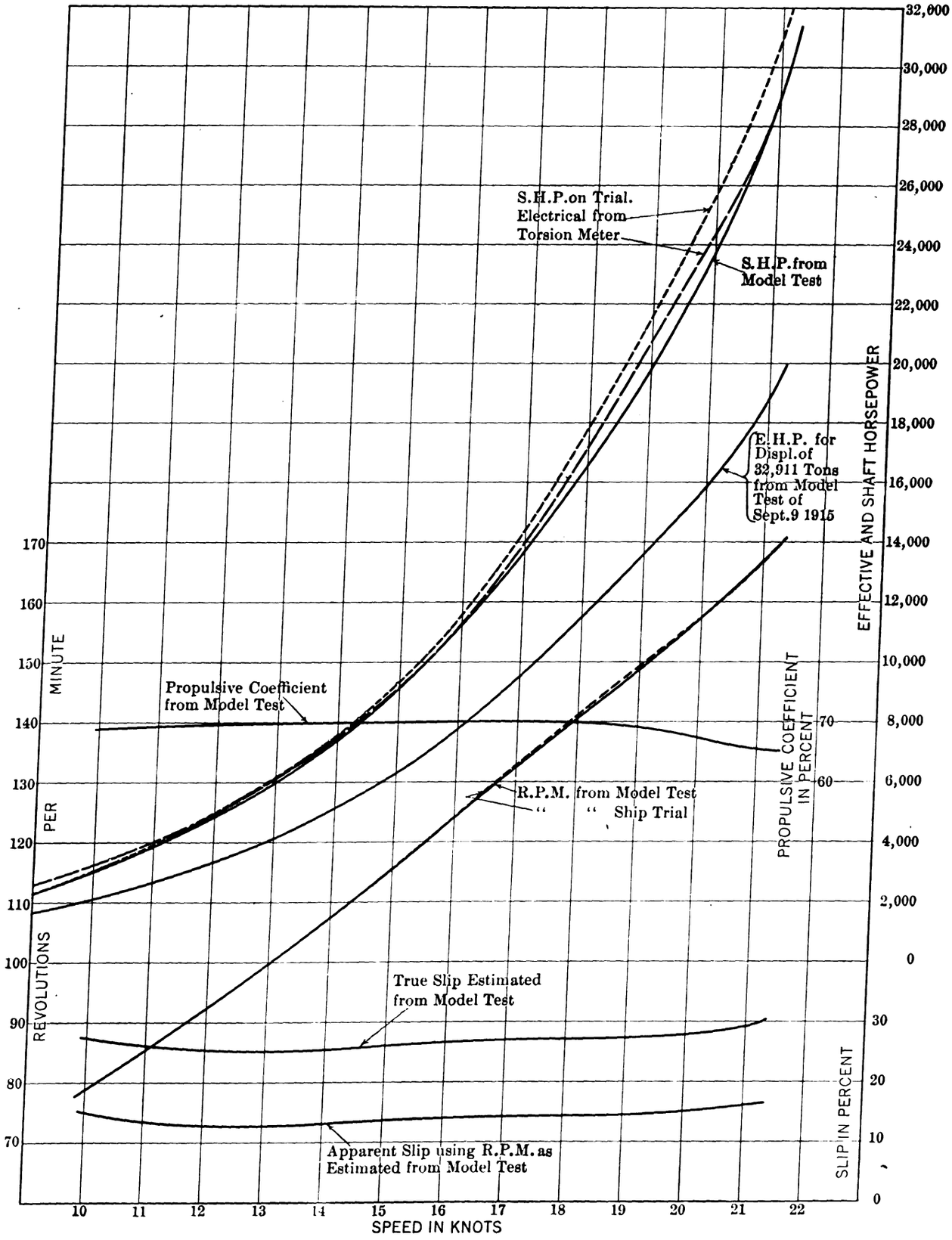

Fig. 3.—U. S. S. *New Mexico*. Comparison of Power and Speed Data on Standardization Trials with Results of Self-Propelled Model Tests (Model No. 1642). Standardization Trials of December 16 to 18, 1918. Length on Load Waterline, 600 Feet; Beam, 97.156 Feet; Draft, mean, 30.823 Feet; Displacement, 32,911 Tons; Diameter of Propeller, 13 Feet 5 Inches; Pitch of Propeller, 15 Feet 2 Inches; Ratio Projected Area to Disk Area, 0.3562; Number of Blades, 3; Number of Propellers, 4; Scale of Model, 1/30 Full Size.

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speed of [illegible] knots may be in error either in the torsionmeter reading, in the speed over the course, or in both. Possibly, also, the power difference may result from erratic steering during the trial of the ship, or insufficient run to attain uniform speed before starting on the measured mile. There is no information, however, in the trial report which would bear out this assumption. It should be noted also that at the lower speed there is some doubt as to the accuracy of the calibration of the electrical meters used for measuring the power input to the motor.

In estimating the shaft horsepower for the ship, the effective horsepower for the model with full appendages,

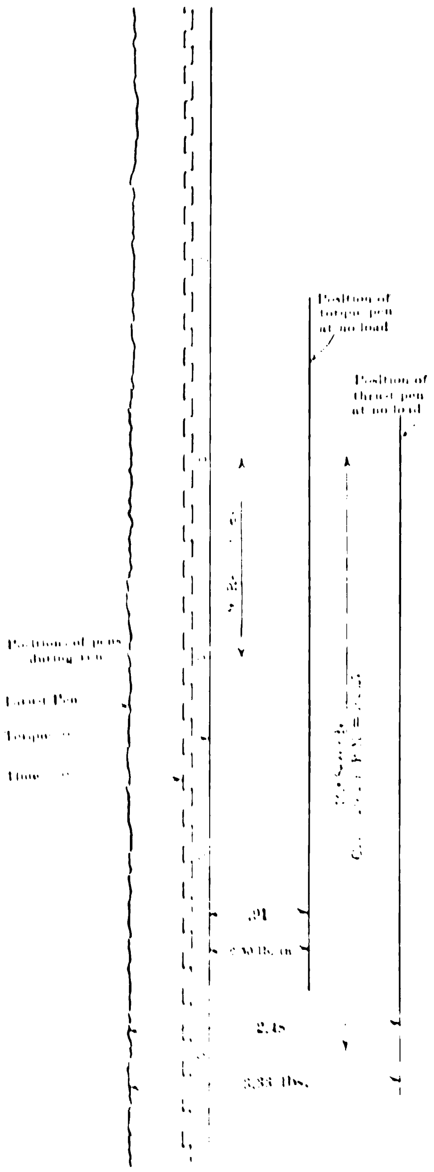

Fig. 4. Dynamometer Card, Showing Propeller Thrust, Torque and Revolutions per Minute

as determined on the Model Basin tests dated September [illegible] 1918, was used. This effective horsepower curve does not take into consideration the resistance of the paravane gear which was rigged on the ship during the trials. From the fact that the shaft horsepower estimated from the Model Basin tests and the revolutions per minute are in close agreement with the results obtained on the trials of the ship, it is apparent that either the paravane gear did not add much to the ship's resistance or that the effective horsepower originally estimated for the ship was high by an amount equivalent to the resistance of the paravane gear.

The average wake factor for the four propellers at a ship speed of 21 knots was found to be .15, with 16 percent apparent slip and 29 percent true slip. With the total power on the model distributed equally between the four shafts, it was found that the outboard shafts ran at about 1 percent higher revolutions per minute than the inboard shafts. The propulsive coefficient is 65.3 percent at 21 knots with a hull efficiency of 100 percent, indicating that the arrangement of shafting, struts and hull clearances for the propellers are very good.

Another conclusion from the investigation and from other similar tests is that the Model Basin method of testing with model propellers fitted to drive a model of a ship may be used with confidence to predict the performance of the ship on trials. There is a limitation, however, in the case of propellers which on the ship are running in the cavitating region, in which event cavitation may be experienced on the ship and not occur on the model.

In addition to the work of this character already done on models of naval vessels, several progressive private shipbuilding interests of the country have been quick to see the advantages of self-propulsion model tests and have arranged to have such tests made on the models of proposed new merchant ships. The law under which the Model Basin was established provides that private shipbuilding companies may have models tested on payment of the actual cost of the work to the Government.

The present cost for making a 20-foot model and testing it for resistance at three or four different conditions of draft is $500 (104 3 4). From these tests the corresponding effective horsepower curves for the ship are computed and given in the report of test. The additional charge for fitting shafts and propellers to the model and making self-propulsion tests in the case of a twin-screw ship is about $300 (62 10 0).

From the latter tests the shaft horsepower, revolutions per minute and propulsive coefficient for the ship at different speeds are estimated and given in the report.

Japanese Shipbuilding in 1919

A REVIEW of Japanese shipbuilding during 1919 published in the *Japan Chronicle* states that the industry was unexpectedly prosperous during 1919, the ships of over 1,000 tons in displacement launched numbering 134, aggregating 610,558 tons. As compared with the previous year, the figures show a decrease of 55 in the number of ships, but an increase of 40,750 in tonnage, showing thereby the construction of comparatively larger ships during the year. Below are given further particulars classified according to different yards:

Yards	Number	Tonnage
Kawasaki	[illegible]	[illegible]
Asano	[illegible]	74,[illegible]
Uraga	[illegible]	45,[illegible]
Mitsubishi	[illegible]	[illegible]
Harima	[illegible]	[illegible]
Osaka Ironworks	[illegible]	[illegible]
Ishikawajima	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	4	[illegible]
Yokohama	4	[illegible]
[illegible]	[illegible]	[illegible]

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Preventing Corrosion in Marine Boilers

BY E. N. SPELLER*, E. G. BASHORE†, ISAAC HARTER†† AND W. W. SMITH‡

This article on the control of corrosion in marine boilers has been prepared as a guide to marine engineers. It is based on what is believed to be the best practical experience. The preparation of these notes was suggested from an investigation of recent disastrous results in tubes in marine boilers where no attention was paid to water treatment.

THE basic causes of corrosion are better understood than they were some time ago, so that it is now possible to figure out and apply the treatment required, so as to keep the boiler water in a relatively harmless condition with some degree of certainty. The treatment described, employs only soda ash and lime—both well known and easy to obtain commercially in a sufficiently pure condition. However, it is recommended that the supply be obtained from reputable dealers under a guarantee. The result of using compounds of unknown composition is uncertain and sometimes harmful.

Treatment of Boiler Feed Water

While it is better practice, as a rule, to treat boiler water before filling the boilers, this is not practicable or effective in the case of marine boilers, on account of the weight and space occupied by a treating plant, and more particularly because the contamination is almost entirely due to leakage of sea water into the boiler system. Furthermore, a good supply of boiler water can usually be obtained, and, of course, the best should be selected, as the less the amount of chemicals added to the boiler the better.

Most natural waters, particularly those which are very pure, are corrosive, so that the instructions as to treatment of new boiler water should be noted and carefully followed, for rust once started often propagates itself, as it were, at a most alarming rate. After the first additions a certain limited degree of alkalinity should be maintained to take care of a reasonable amount of salt-water leakage. An excess of alkalinity is harmful, therefore the maintenance of the water in the boilers in the best condition, all things considered, depends primarily on a daily system of testing and records.

In preparing these notes all mention or discussion of the chemistry of the reactions which take place in boilers has been purposely avoided. The procedure has been defined in practical terms for the use of assistant engineers in their daily routine.**

Causes of Corrosion in Boilers

The principal causes of corrosion and pitting in marine boilers may be classified as due to:

(1) Air in the feed water.

(2) Organic or fatty acids from greases and oils.

(3) Presence of sea water.

(1) The oxygen component of air is somewhat soluble in water, and in this form promotes rapid corrosion. The exact mechanism of corrosion through the agency of dissolved oxygen need not be explained, since this particular point involves certain theories concerning which there is a variance of opinion. The fact remains that oxygen dissolved from air by water is probably the greatest accelerator of corrosive action and should be removed.

(2) Organic acids find their way into the feed-water system, in lubricants compounded with animal or vegetable oils. The decomposition of compounded lubricants takes place in a manner similar to that in which a fat is decomposed by soapmakers with the liberation of glycerine and fatty acids. The glycerine dissolves in the water, and the fatty acids are free to attack the metal parts of the boiler.

(3) Sea water is in part made up of the constituents shown in the following average representative analysis:

Calcium sulphate	70	grains	per U. S.	gallon
Magnesium sulphate	130	"	"	"
Magnesium chloride	140	"	"	"
Sodium chloride	1,700	"	"	"

The magnesium chloride is the most harmful component, for, under the influence of temperature and pressure in the boiler, this salt dissociates into hydrochloric acid and magnesium hydrate; the acid, in contact with the iron, forms iron chloride, which, in turn, reacts with the free magnesium hydrate in the water, thereby precipitating hydrate of iron and re-forming magnesium chloride. This cycle of reactions is repeated, so that a small amount of magnesium chloride is capable of doing serious damage. Under certain conditions magnesium sulphate is also decomposed in the same way into magnesium hydrate and sulphuric acid, but this reaction does not take place to the same extent as with magnesium chloride.

General Methods of Preventing Corrosion

Having discussed in a general way the three main causes of corrosive action common to marine boilers, the means of prevention will be discussed in the same order of sequence:

(1) As previously stated, the oxygen component of air is somewhat soluble in water, and in this form promotes rapid corrosion. Solubility of oxygen increases with pressure increase and decreases with temperature increase. These factors governing the relative degree of solubility of oxygen in water suggest the following means for prevention of corrosion:

(a) Heating the water in the boiler under atmospheric pressure by means of circulators, or in the absence of circulators, by boiling the water for a short time under atmospheric pressure by means of direct fire, before closing up the boilers.

(b) Keeping the water in the feed-water tank at the highest practicable temperature with least surface exposed to air.

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‡ Chief engineer, Federal Shipbuilding Corporation, Kearney, N. J.

** Those who care to study the chemistry of boiler water treatment are recommended to secure and read copies of the following:

Naval Standard Boiler Testing Outfit, Bureau of Steam Engineering, Washington, D. C.

The Reports of the Committee on Water Service of the American Railway Engineering and Maintenance of Way Association, which give methods of water softening and of analytical control.

"Boiler Feed Water," by Anderson. (D. Van Nostrand Company, New York).

"Purification of Water for Use in Steam Boilers," J. O. Handy, Proceedings of Engineers' Society of Western Pennsylvania, January, 1899.

"Boiler Waters: Their Chemical Composition, Use and Treatment," by W. T. Read, University of Texas Bulletin No. 1752, Austin, Texas.

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(c) Keeping the pump glands in suction joints tight to avoid drawing in air. All feed-pump suctions should be entirely covered with water at all times.

(d) Filling the available space in the feed-water tank with steel-metal lathing. This will fix the remaining traces of free oxygen by a rusting action on the surface of the lathing thus exposed.

(2) Since it is the animal or vegetable constituent which is responsible for the corrosive action by lubricating oils, the best means of prevention is to use only oils having a pure mineral base, and not compounded oils. It should be borne in mind that it is more important to protect the boilers from the possibility of acid attack than to obtain perfect internal lubrication. The precaution of purchasing only mineral oils for lubrication is to be emphasized not only from the corrosion standpoint, but because such oils prevent wet steam formation through foaming. Fatty acids combine with alkalies to form soluble soaps, and obviously soap dissolved in boiler water would lead to a condition of severe foaming.

(3) The statement has been made that sea water is corrosive, because of the decomposition of its magnesium chloride component at high temperature and pressure. Magnesium chloride may contaminate the feed-water supply through sea-water introduced from four possible sources:

(a) Condenser leakage.
(b) Inter-communicating valve leakage.
(c) Steam heaters of salt water.
(d) Leakage or priming of evaporators.

Magnesium chloride corrosion may be prevented in two ways:

(a) By avoiding the introduction or leakage of any sea water into the feed-water system, from any of the sources enumerated in the foregoing.
(b) By chemical neutralization.

Magnesium chloride can be neutralized by soda ash, and in this system the sodium chloride, or common salt, content of the water is taken as the measure of the quantity of soda ash required for neutralization of the magnesium chloride, which is also present.

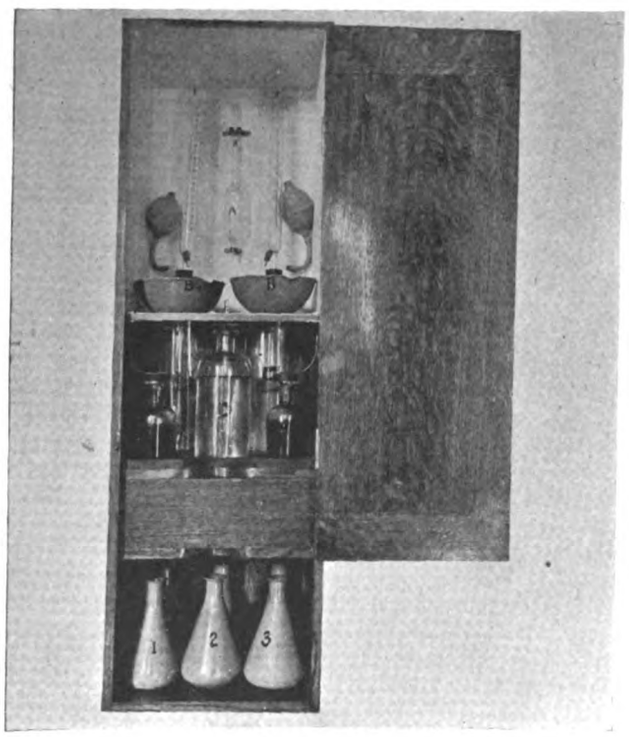

Fig. 1.—Testing Kit

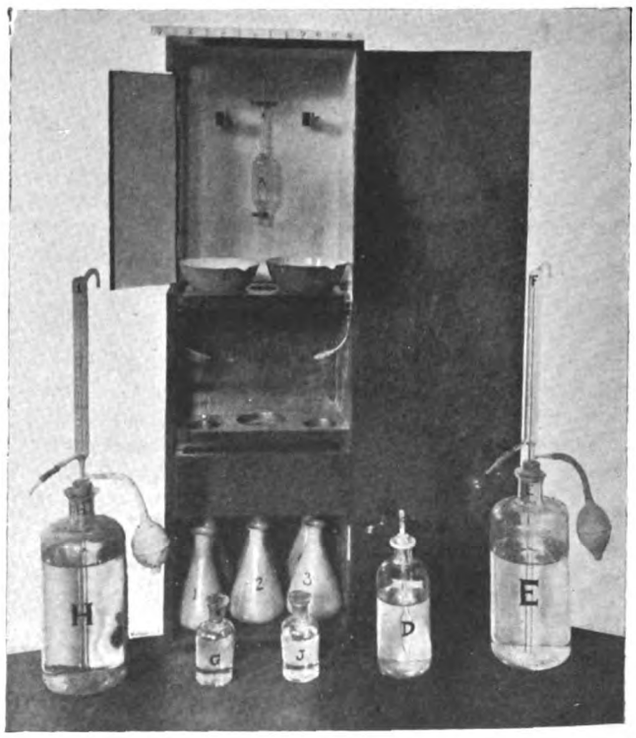

Fig. 2.—Testing Kit Ready for Use

Special Safeguards Against All of the Causes of Corrosion Combined

Special safeguards against all of the causes of corrosion combined may be classified under two headings:

(1) Lime addition to the water in the boiler.
(2) Maintenance of alkaline water in the boiler by periodic additions of soda ash.

(1) The reason for the use of lime is the conversion of magnesium chloride into magnesium hydrate and calcium chloride, neither of which is corrosive; and, more especially, the formation of a light scale on the surface of metal, thus preventing the corrosive elements from coming in contact with the iron.

When starting with new boilers on a voyage for the first time, after thorough cleaning,* ten pounds of lime (dissolved in cold water and run in through manhole) should be put into the boilers for every 30,000 pounds water capacity, and four to six pounds of lime per day for every 30,000 pounds water capacity should be passed through the hot well (as milk of lime) for about six days. Milk of lime is a mixture of about one pound of unslaked lime, or 1⅓ pounds of hydrated lime, with a gallon of water. Lime additions are to be made only when the boilers are new or after retubing.

(2) The fact has been established that by maintaining alkaline water in the boiler the tendency towards corrosion is greatly lessened. Certain purely theoretical considerations support this statement; however, for the object at hand a simple statement of fact is sufficient.

The limit of the amount of this alkalinity has been purposely fixed at 15 grains per gallon. This means excess soda ash to the extent of 15 grains per gallon over and

* See section dealing with "General Practice," page 426.

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above the amount necessary to combine with the magnesium chloride (and other scale-forming) components of the water. While 15 grains of excess alkalinity is stated as the desirable amount, it is recognized as impracticable for the operator in charge regularly and consistently to carry the prescribed 15 grains. For this reason it is better to work between the limits of 10 and 20 grains, and to try in so far as possible to aim at an excess alkalinity figure of 15 grains. While water is improved from a corrosion prevention standpoint through the agency of excess alkalinity, on the other hand too great an excess would be liable to bring about dangerous operating conditions through the embrittling of the steel in the boilers. Therefore, the importance of establishing and maintaining a limited degree of excess alkalinity is to be emphasized; the safe limits lie between 10 and 20 grains per gallon.

It is desirable to call attention to the distinction between the two uses of soda ash, namely, the one use of maintaining alkaline water in the boilers, and the other use of bringing about a neutralization of the magnesium chloride content of the water.

In the first case the soda ash is intended to remain uncombined; and if no substances are present with which it can react, then one addition would be sufficient. In the case of salt water leakage in the boilers, however, the additions must be repeated as long as magnesium chloride is being added to the system. Both objects are accomplished and controlled through the use of the testing kit described below.

OPERATION OF THE TESTING KIT

The testing kit consists of the assembled glass apparatus and reagent bottles as shown in Figs. 1 and 2. Each glass container is marked with an identifying letter, and the letters follow in sequence of the different operations in conducting the test.

It is suggested that the instructions for conducting the tests be carefully read over, and then the actual manipulations be tried, using pure or distilled water until the operator becomes thoroughly familiar with the color changes which take place. In the actual determination on samples, which are to be reported on the log sheet, time must be allowed for the cooling of the sample to the room temperature before conducting the test.

It is necessary to have a definite volume of test water to start with. A sample should be taken in a glass receptacle which has been thoroughly washed out with the water to be tested.

(*A*).—For this purpose the measuring pipette *A* is provided. Fill the 50 cubic centimeter pipette *A* with the boiler water by gentle suction with the mouth to a point slightly beyond the scratch mark on the stem of the pipette, holding the charge of water in the pipette through pressure applied at the suction end with aid of the index finger. Now gently release the pressure until the water drops to the scratch mark level.

(*B*).—Deliver the unit charge of water thus taken to the white porcelain dish marked *B*.

(*C*).—With pipette *C* manipulated in the same manner as described under (*A*). Fill exactly to the scratch mark on pipette *C* with the solution in the bottle marked *D*. A piece of rubber tubing supplied with the kit may be put over the suction provided any difficulty is experienced in filling to the scratch mark.

(*D*).—The exact quantity of solution *D* should then be added to the water sample contained in porcelain dish *B*.

(*E*).—Now transfer the solution from large bottle *E* by gently blowing in the rubber tubing connected with the bottle through the double hole rubber stopper so that solution *E* passes into burette *F*.

(*F*).—Continue the pressure until the level of the solution in *F* is a little higher than the outlet to the fixed level elbow bend at the top of *F*. By releasing the pressure the solution should flow back so that the level stands at a fixed position at the top of *F* located by red graduation mark 5. It is absolutely essential that the volume of solution in *F* be brought to the constant level as shown by red graduation mark 5, otherwise the results will be in error. Having filled burette *F* in the manner described, the next step is to color the sample of water in the porcelain dish *B* with an indicator for this purpose.

(*G*).—Five drops of solution *G* is added to the water sample in *B*. This quantity of indicator *G* should be sufficient to color the water a light orange or straw color. Now by applying pressure with the thumb and index finger on the rubber around the tit outlet, to burette *F*, the solution in *F* can be dropped gradually into water sample in *B*. Fig. 3 illustrates the principle involved.

Continue the dropping of solution contained in burette *F* into water in *B*, meanwhile stirring constantly with a glass rod provided with the kit, until there occurs a change in color from a light yellow-orange to a red color.

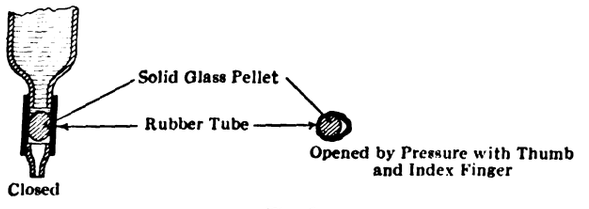

Fig. 3

At the instant this color change takes place, stop any further addition from burette *F* and immediately take the reading on the burette. This reading is recorded on the log sheet as *F*.

This reading should be a white-line graduation reading and preferably around the graduation 15, indicating 15 grains of alkalinity in terms of soda ash per gallon of water.

This completes the determination of the alkaline (or acid) condition of the boilers, and the next step is to test for the quantity of salt in the boilers. Interchange the position of *B* dishes, carefully moving the one containing the sample under the second burette, then drop by drop with constant stirring add solution *D* from pipette *C* until the red color again changes back to a yellow orange. Usually one to two drops of solution *D* will be sufficient for this change.

(*H*).—The solution *H* should be forced over into burette *I*.

(*I*).—Forcing the solution into burette *I* should be done in a manner similar to that employed in filling the first burette.

Care should be taken not to overflow the side outlet tube, at the same time remembering that it is absolutely essential that the solution be brought to the top constant level device, and at a level in line with the zero reading. After *I* has been filled, the next step is to add five drops of indicator *J*.

(*J*).—The addition of five drops of indicator *J* will not cause a very noticeable change in the color of the solution. Now pressing the rubber pinch cock at the outlet of *I*, drop the solution into porcelain dish *B*, constantly stirring the sample in *B*, and continue the dropping until the color of the body of liquid changes from an orange yellow to a red color. On the first addition of the solution a white curdy precipitate will form, but this in no way will interfere with the final red color. The moment this

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change takes place stop the addition of solution from *I* and note the reading on the burette *I*.

The reading *I* should preferably be below the 100 graduation mark, which would be an indication that the boilers were carrying less than 100 grains per gallon of sodium chloride (salt). The burette *I* is graduated so that the smallest subdivision is equivalent to 10 grains per gallon. Provided the reading *I* happened to come to the first division below the 200, then the proper entry for *I* reading would be 210 grains of sodium chloride (salt) per gallon. Entry of the *I* reading should be made at the proper place provided for the same on the log sheet.

(*K*).—The *K* number indicates the increase in grains per gallon of sodium chloride over a certain period of time (preferable 24 hours), and therefore is arrived at by subtracting the previous log reading from the present log reading. In other words, assume that the water sample on starting the boilers showed an I_1 reading of 10 grains per gallon of sodium chloride (and this had already been treated for in a manner which will be described later); and on the next 24-hour period the I_2 reading gave 30 grains per gallon, then 10, the previous I_1 reading, subtracted from 30, the present I_2 reading, gives *K* number 20.

Sampling, Soda Ash Additions, and Log Records

It is advisable to sample and treat each boiler individually, for the reason that the water in different boilers will vary, and it is the water condition of each boiler which determines whether, or not, that particular boiler is liable to corrosion.

In conducting the tests and administering the soda ash treatment, it is to be recommended that a twenty-four-hour period be established as the working basis. All of the engineering officers should have a working knowledge of the details of the method, but the second assistant engineer aboard the ship should be held directly and specifically responsible for the fulfillment of the duties as set forth.

Samples shall be taken from the salinometer cock or from a special valve directly connected to the shell of each boiler every twenty-four hours, and the readings as the result of testing each water sample entered on the log sheet at the time the tests are made.

The proper amount of soda ash to be added to each boiler over a twenty-four-hour period is determined by the *K* number. The *K* number indicates the *increase of sodium chloride* in comparison with the previous twenty-four-hour period, and therefore is arrived at by subtracting the previous I_1 reading from the present twenty-four-hour period I_2 reading. The amount of soda ash corresponding to the *K* number will naturally vary, depending upon the water capacity of each boiler.

Tabulated sheets follow giving the requisite amount of soda ash for corresponding *K* numbers covering boiler water capacities of each boiler from 10,000 to 19,000 pounds. After having conducted the test, and thereby determined the *K* number, the corresponding quantity of soda ash required for the particular boiler in question should be added to a suitable tank and put into solution through the addition of ten to twenty gallons of water, at the same time stirring until completely dissolved, then feed to the particular boiler to which the addition is to be made, by introducing the solution through the suction end of the auxiliary feed pump.

Daily tests of water from the feed tank should be made in the same way. This water will normally be neutral and free from more than a trace of chlorides. Should the I_2 reading be higher than I_1, to any extent in the feed tank sample, and a high *K* number is found on the boiler samples, the source of the leak should be found and should receive attention as soon as possible. Should the *K* number in the boiler samples be insignificant under these conditions, the chlorides in the feed water probably came from foaming in one or more of the boilers. With a little experience the engineer will be able to use these means to trace the origin of other leakages.

A facsimile of the form to be used in reporting the tests is shown below, and at the end of the article will be found the tabulation of the required number of pounds of soda ash corresponding to the *K* number, covering a range of from 10,000 pounds to 19,000 pounds boiler water capacity.

BOILER WATER TEST LOG

Ship .....
Time.....A. M. or P. M.
Date .....
Tested by .....

	Boilers 1	2	3	4	5	6	Feed Tank
Water capacity of each boiler....							
F—Reading (red line).....							
F—Reading (white line).....							
I_2 Reading (present *I* reading)..							
I_1 Reading (present *I* reading)..							
K—number = $I_2 - I_1$.....							
Water capacity of each boiler....							
Soda ash added—pounds.....							
Time added							

NOTE.—If the *F* reading falls within the red lines this indicates an acid condition of water, which is extremely dangerous.

Rule for Soda Ash.—The *K* number indicates the increase of sodium chloride in comparison with the previous boiler-water test log, and therefore is arrived at by subtracting the previous log reading (I_2) from the present log reading I_1. Refer to the tabulation corresponding to the water capacity, and from the above *K* number note the required amount of soda ash directly opposite.

Maintaining the Proper Degree of Alkalinity

The method of determining the proper amount of soda ash has been outlined in detail; however, nothing has been said with regard to maintaining the proper degree of alkalinity—15 grains per gallon—within the water system. Attention is called to the fact that the required amount of soda ash corresponding to the *K* number takes care only of the fresh sea water, which has found its way into the system and does not allow for the excess (15 grains per gallon) which is desirable. This is readily calculated, and below is shown the pounds of soda ash equivalent to 15 grains per gallon in excess for the total water capacity of the ship's system, varying from 50,000 to 150,000 pounds:

Water Capacity—Pounds	Pounds of Soda Ash Required to Give an Excess of 15 Grains Per Gallon
50,000	13
60,000	16
70,000	18
80,000	21
90,000	23
100,000	26
110,000	28
120,000	31
130,000	33
140,000	36
150,000	38

When starting the boilers with fresh water for the first time, the amount of soda ash to be added to the water system is determined by the total water capacity of the ship's system. This soda ash treatment should not be started until the lime additions referred to on page 422 paragraph (1), are completed. If, for example, the total water capacity happens to be 60,000 pounds, then by referring to the foregoing tabulation the amount of soda ash to be added to the system would be 16 pounds, or with a water capacity of 120,000 pounds the amount of soda ash would be 31 pounds. After making the requisite addition of soda ash, and allowing time for complete solution and distribution through the system, the correctness of the amount should be checked through the taking of a sample of water and testing for alkalinity. The reading should give between 10 and 20 grains per gallon of alkalinity in each boiler.

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10,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.37	160	6.00
20	.75	170	6.37
30	1.12	180	6.75
40	1.50	190	7.12
50	1.87	200	7.50
60	2.25	210	7.87
70	2.62	220	8.25
80	3.00	230	8.62
90	3.37	240	9.00
100	3.75	250	9.37
110	4.12	260	9.75
120	4.50	270	10.12
130	4.87	280	10.50
140	5.25	290	10.87
150	5.62	300	11.25

11,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.413	160	6.61
20	.83	170	7.02
30	1.24	180	7.43
40	1.65	190	8.26
50	2.06	200	8.67
60	2.48	210	9.08
70	2.89	220	9.50
80	3.30	230	9.91
90	3.72	240	10.32
100	4.13	250	10.73
110	4.54	260	11.15
120	4.96	270	11.56
130	5.37	280	11.97
140	5.78	290	12.39
150	6.19	300	

12,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.451	160	7.22
20	.90	170	7.67
30	1.35	180	8.12
40	1.80	190	8.57
50	2.25	200	9.02
60	2.71	210	9.47
70	3.16	220	9.92
80	3.61	230	10.37
90	4.06	240	10.82
100	4.51	250	11.27
110	4.96	260	11.72
120	5.41	270	12.17
130	5.86	280	12.63
140	6.31	290	13.08
150	6.76	300	13.53

13,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.489	160	7.82
20	.98	170	8.31
30	1.47	180	8.80
40	1.96	190	9.29
50	2.45	200	9.78
60	2.93	210	10.27
70	3.42	220	10.76
80	3.91	230	11.25
90	4.40	240	11.73
100	4.89	250	12.22
110	5.38	260	12.71
120	5.87	270	13.20
130	6.36	280	13.69
140	6.85	290	14.18
150	7.33	300	14.67

14,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.527	160	8.43
20	1.05	170	8.96
30	1.58	180	9.49
40	2.11	190	10.01
50	2.63	200	10.54
60	3.16	210	11.07
70	3.69	220	11.60
80	4.21	230	12.12
90	4.74	240	12.65
100	5.27	250	13.17
110	5.80	260	13.70
120	6.32	270	14.23
130	6.85	280	14.76
140	7.38	290	15.28
150	7.91	300	15.81

15,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.565	160	9.04
20	1.13	170	9.60
30	1.69	180	10.17
40	2.26	190	10.73
50	2.82	200	11.30
60	3.39	210	11.86
70	3.95	220	12.43
80	4.52	230	13.00
90	5.08	240	13.56
100	5.65	250	14.12
110	6.22	260	14.69
120	6.78	270	15.25
130	7.35	280	15.82
140	7.91	290	16.38
150	8.48	300	16.95

16,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.603	160	9.65
20	1.21	170	10.25
30	1.81	180	10.85
40	2.41	190	11.45
50	3.01	200	12.06
60	3.62	210	12.66
70	4.22	220	13.26
80	4.82	230	13.87
90	5.43	240	14.47
100	6.03	250	15.07
110	6.63	260	15.68
120	7.23	270	16.28
130	7.84	280	16.88
140	8.44	290	17.48
150	9.04	300	18.09

17,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.641	160	10.25
20	1.28	170	10.90
30	1.92	180	11.54
40	2.56	190	12.18
50	3.21	200	12.82
60	3.85	210	13.46
70	4.49	220	14.10
80	5.13	230	14.74
90	5.77	240	15.38
100	6.41	250	16.02
110	7.05	260	16.66
120	7.69	270	17.30
130	8.33	280	17.95
140	8.97	290	18.59
150	9.61	300	19.23

18,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.679	160	10.86
20	1.36	170	11.54
30	2.04	180	12.22
40	2.72	190	12.90
50	3.40	200	13.58
60	4.07	210	14.26
70	4.75	220	14.94
80	5.43	230	15.62
90	6.11	240	16.30
100	6.79	250	16.97
110	7.47	260	17.65
120	8.15	270	18.33
130	8.83	280	19.01
140	9.51	290	19.69
150	10.18	300	20.37

19,000 POUNDS WATER CAPACITY

K Number	Pounds Soda Ash to Be Added	K Number	Pounds Soda Ash to Be Added
10	.717	160	11.47
20	1.43	170	12.19
30	2.15	180	12.90
40	2.87	190	13.62
50	3.58	200	14.34
60	4.30	210	15.05
70	5.02	220	15.77
80	5.74	230	16.49
90	6.45	240	17.21
100	7.17	250	17.92
110	7.89	260	18.64
120	8.60	270	19.36
130	9.32	280	20.08
140	10.04	290	20.79
150	10.75	300	21.51

CASE WHERE THE WATER IS SLIGHTLY ACID

One possible case which has not been discussed is where the water is slightly acid, or in other words gives an *F* reading within the red-line marks of burette *F*. In such a case, obviously the water has used up the excess alkalinity, and therefore, in addition to the soda ash required by the *K* number, an amount must be added equal to the quantity shown for the corresponding water capacity, plus an additional amount proportionate to the acidity.

In event it becomes necessary to blow down the boilers and use makeup water in addition, the only complication this condition adds to the method is, that it becomes necessary for the engineer to estimate the quantity of makeup water to be added to the system. Having estimated the quantity of makeup water required, by referring to the tabulation it is a matter of simple division and multiplication to estimate the requisite amount of soda ash to be added in order to establish a condition of 15 grains per gallon of alkalinity.

Should the feed tank sample or the boiler water samples consistently show an alkalinity several grains below the 15 mark, say around 5 or 7, then it would be advisable to increase the soda ash additions as indicated by the *K*

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number. In this case, care should be taken not to overdose the boilers, remembering that 20 grains per gallon of alkalinity should not be exceeded, and that 15 grains is the desired amount.

GENERAL PRACTICE

In discussing boiler operation from the feed-water standpoint, it is necessary to consider the accessories to the boiler as well as the boiler itself.

Every effort should be made to keep the condensers tight and prevent any leakage of salt water to the feed system. Whenever the tubes of condensers are found to be leaking, steps should be taken without delay to locate and stop such leaks and prevent the admission of salt water to the boilers.

The boiler-feed pump should not be used for other purposes than those connected with the service of the boiler or feed water, except in cases of emergency. When not under steam their piston and valve gears should be moved every day.

The interior of the evaporators should be examined, and the tubes or coils cleaned and scaled at as frequent intervals as practicable. When an evaporator is not required for use for several days the shell and coils or tubes should be drained and kept dry until needed for service.

Boilers which are to be idle for a considerable length of time should be emptied, and their interiors should be thoroughly dried. Open trays of as large capacity as practicable should be filled to about half their height with quicklime, which in turn should be introduced through the manhole into the drum of the boilers. The boilers should then be closed airtight, and special precautions taken to prevent any moisture entering the interiors while they are being thus treated.

During the construction and installation of boilers, more or less grease finds its way into the plates and tubes. This condition should be taken care of by adding soda ash to the water and boiling out for a period of at least 48 hours. After emptying the boilers they should be thoroughly washed with a hose carrying water at high pressure.

Progressive Ship Construction

IN order to overcome what are considered to be wastes in the efficiency of space and equipment utilization in the shipyards, Roberto Gallazzi, of the S. A. I. Gio, Ansaldo and Company, Genoa, Italy, has developed a method of ship production designed to speed up operations.

The idea is in effect the application of the same principles to the construction of large ships as were utilized in building the "Eagle" type submarine chasers in the Ford plant during the war. Instead, however, of the various fabricating processes being carried out while the boat progresses from one station to another on trucks, the new system provides a channel in which the partly constructed hull floats. On either side of this channel are shops from which the assembled plates, fittings, machinery and other equipment are installed in the vessels.

The recommendations for such a system of ship fabrication seem to be the division of labor and the reduction of material handling, as well as the elimination of building ways and the duplication of crane and other equipment. The present wet dock for fitting out ships is really a limited application of the idea.

APPLICATION OF METHOD TO CARGO BOATS

For freighters of 8,000 tons deadweight, the building channel, as it is called, occupying the central part of the yard, is about 60 feet wide and 2,500 feet long. The height of the ground level above the water level is about 11 feet. From the ground level the depth of the channel in different sections, corresponding to six stages in the construction of a vessel, is, in the first section, which is a dry dock, about 23 feet, and in the other five sections 19, 20, 21, 22, and 25 feet respectively.

In the dry dock section the hull is commenced and built up sufficiently to carry the stresses when the ship is

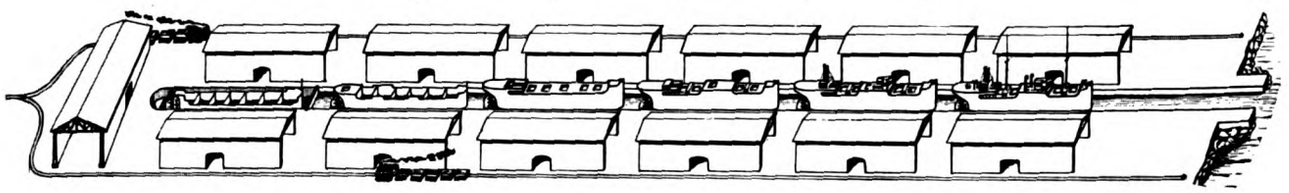

Fig. 1.—Perspective Sketch of Proposed Shipyard for Progressive Construction

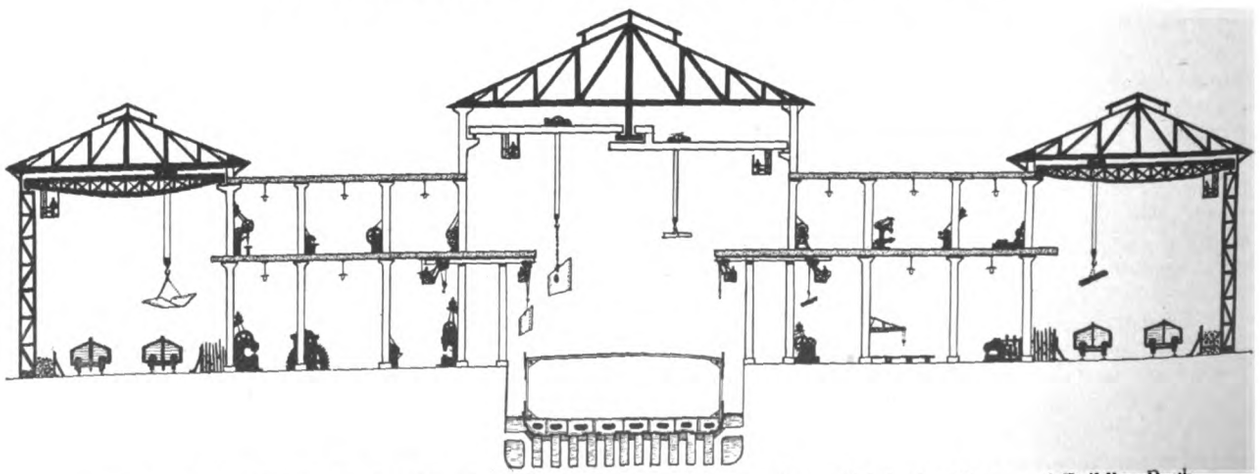

Fig. 2.—Section Through Yard at First Stage, Showing Material Storage Space, Fabricating Shops and Building Berth

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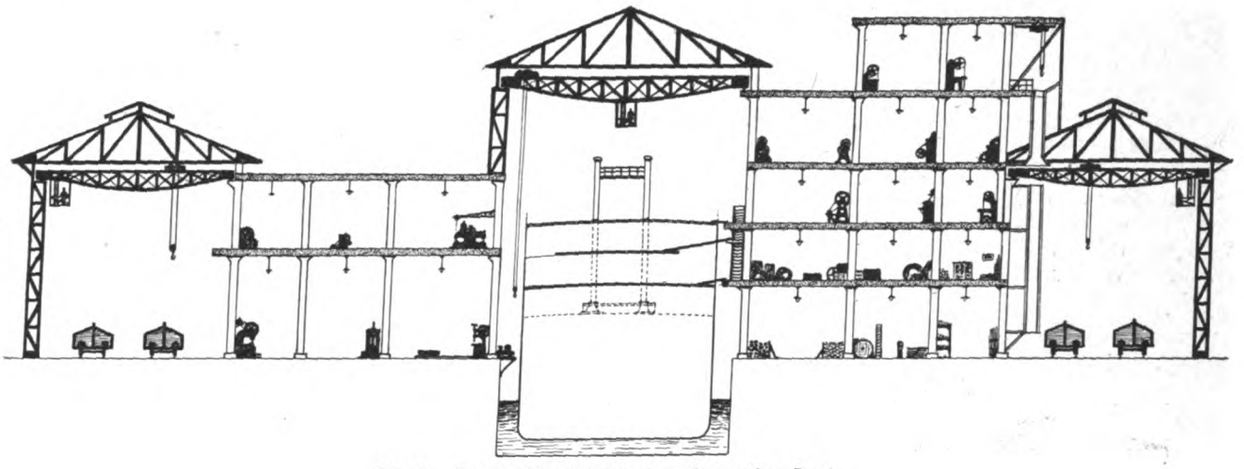

Fig. 3.—Section Through Yard at Fitting-Out Berth

floated. A double bottom, floors, main frames, lower deck beams, outer plating to the lower deck, keelsons, stringers, transverse bulkheads, are all assembled at this stage and part of the painting done. The water is then admitted to the dry dock and the partially built hull floated and towed to the second section. In this section the plating is completed, longitudinal bulkheads and stringers fitted, upper tanks installed and more of the painting completed, after which the ship advances to the next station. Superstructure, hatchways, ventilators and the like are fitted here. At the next three stations the machinery, deck fittings, distiller, joiner work, rigging, carpenter work, electrical equipment, anchors, chains, lifeboats, etc., are installed and the ship is ready for her trials.

At each station the shops are arranged so that material is handled in an efficient manner.

Waterfront Development in Winter at Northern Ports

BY H. MC L. HARDING*

FROM experience lately gained in the construction of the new port works of the city of Milwaukee, Wis., it has been ascertained not only that the work can be continued during the winter months, but that it can be carried on more rapidly and at even a less cost than during the summer.

In the driving of piles, the placing of timber and the installing of various terminal facilities, which has always been considered difficult, if not almost impossible, during severe cold weather, the work has now been found easy—in fact, it has been more advantageously done in winter than at other times. Hitherto the usual custom has been to shut down until spring.

At Milwaukee, along the inner shore of Jones Island, there is being built about 1,600 feet of quay construction consisting of the driving of rows of vertical and batter piles and attaching longitudinal and other timbers to these piles. The depth of the water near the shore, especially where the inner rows of vertical and batter piles are being driven, varied from one to three feet. This section is later to be filled with earth.

In the summer it would have been necessary to have dredged sufficiently deep to bring the scow supporting the pile-driving machinery close to the shore or else to have erected false work along or near the bank. Either of these methods would have been expensive and have consumed much time in preparation.

During this winter for an average distance of some seventy feet from the shore the ice was frozen some two feet in thickness, and when the water was less than two feet in depth the earth under the ice was also frozen.

It was suggested that some 12-foot by 12-inch timbers be laid upon the ice and upon these rollers, and on these rollers be placed the framework of pile drivers and the house containing the winches, the boilers and other accessories.

With a bar a small hole a few inches deep was started in the ice, and by means of a steam jet from the boiler in about five or six minutes a hole in the ice was made and enlarged and the frozen earth beneath was sufficiently softened so that the vertical and batter piles could be freely and easily driven. After this driving the alinement, not only of the vertical but also of the 30-degree batter piles, was so perfect that it was impossible to detect any variation from a straight line.

After the several rows of piles were driven the longitudinal and other timbers were placed in position, the cutting for these in the ice was also carried on from the surface of the ice. The steam jet apparatus consisted of a flexible-armored hose with a pipe one inch in diameter bent at right angles.

It was estimated from the progress already made that the number of piles driven in a day through the ice was about double that which would have been possible in summer from the floating scow.

The winches for operating grab buckets were sheltered in the movable houses and similarly were moved to and fro upon timbers on the ice where desired. The men, even those occupied outside the houses, could keep warm by going for a few minutes into the boiler houses. There were intervals during the driving of the 60-foot piles when the men were more comfortable than when working in the cold water during the spring and fall. The lost days due to inclement weather were not more than during the other seasons.

It is a source of much gratification that the waterfront development of northern ports is not to be suspended in such cases during the winter, and that the work can be continued, the men continuously employed, and even better progress made. This possibility of winter construction is of great value on the upper Mississippi and other northern rivers, and at other ports than Milwaukee of the Great Lakes, where construction has generally ceased upon the advent of cold weather.

* Consulting engineer, Harbor Commission, Milwaukee, Wis.

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Cramp's Floating Machine Shop

BY LOUIS P. MAIER*

A NUMBER of shipyards along the Atlantic coast have floating repair shops, but for compactness, combined with the large variety of work that can be done at one time, the floating machine shop designed, built and operated by the Kensington shipyard department of the William Cramp and Sons Ship and Engine Building Company, of Philadelphia, Pa., is in a class by itself.

Soon after the war started the management of the Cramp Company realized the need of providing some adequate means for expediting the work of repairing the various transports coming to the port of Philadelphia for taking on board troops and supplies. The shipyard was situated about three miles from the government piers:

* Engineering superintendent, Kensington Shipyard, William Cramp and Son Ship and Engine Building Company, Philadelphia, Pa.

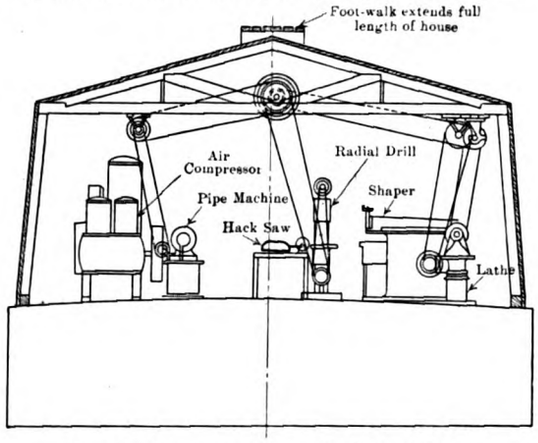

Fig. 1.—Section at Forward End of Barge

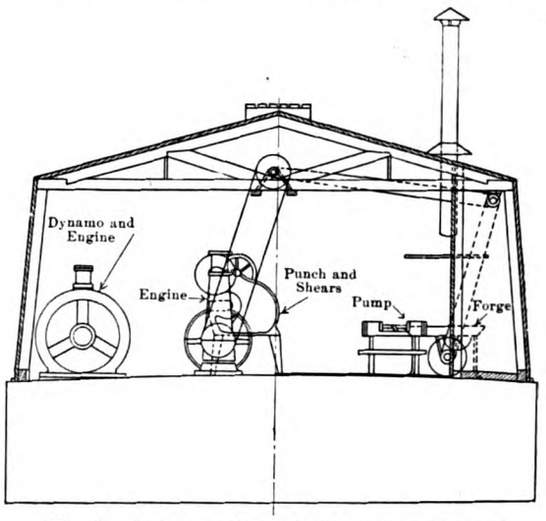

Fig. 2.—Section on Line *A-A*, Looking Forward

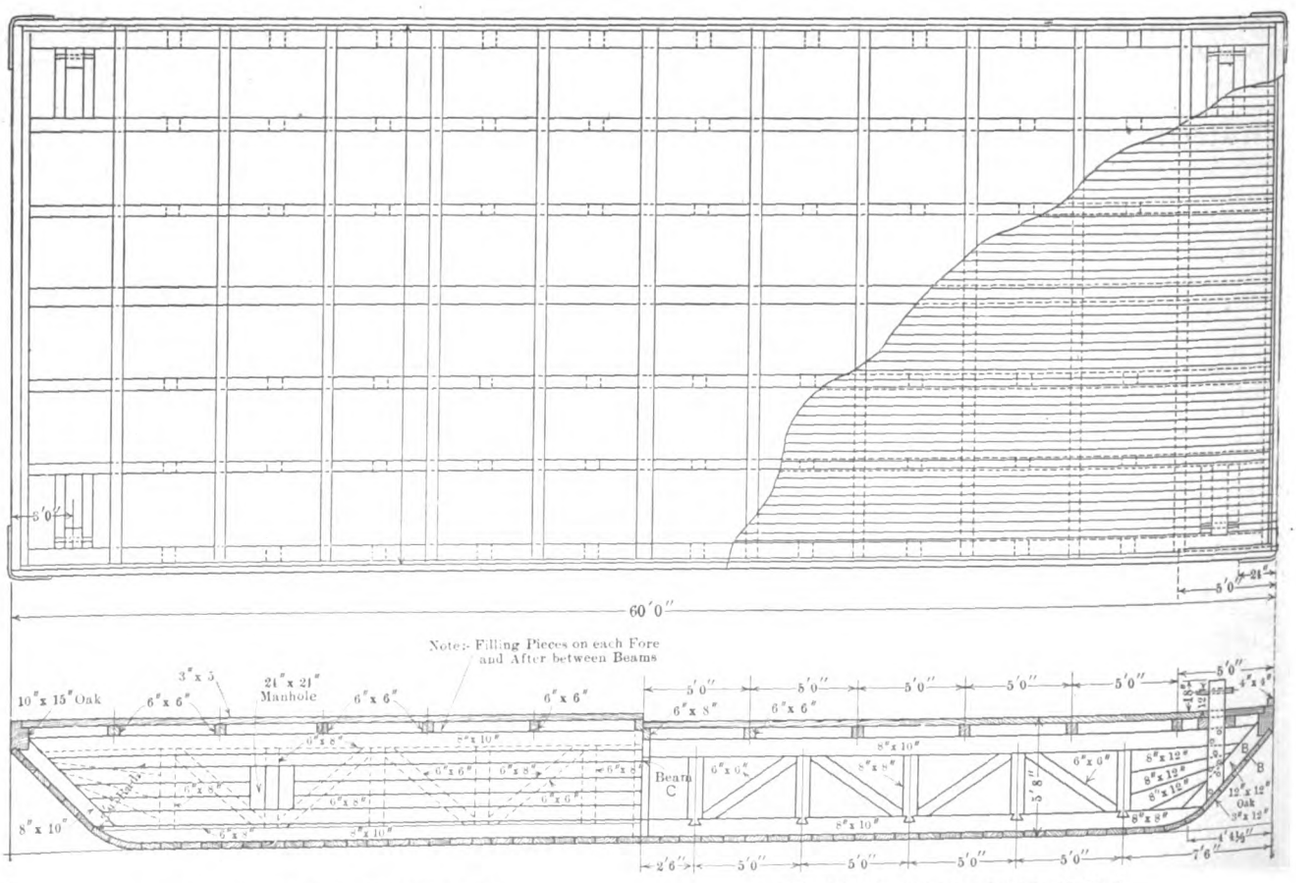
60′0″
Note:- Filling Pieces on each Fore and After between Beams
10″x 15″ Oak
21″x 21″ Manhole
Beam C
LONGITUDINAL SECTION ON FRAME No. 4
LONGITUDINAL SECTION ON FRAME No. 1

Fig. 3.—Construction Plans of Hull

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therefore, a great deal of time was lost in transporting parts of machinery from the transports to the shops and then back to the ships again. It was impossible to rent a shop near the vessels, so it was decided to build a floating shop and equip it with the necessary tools to do the ordinary run of work as was at that time required.

A scow 66 feet long, 25 feet wide and 5 feet 8 inches deep, as shown in Fig. 3, was built and launched. A house was then erected on the scow, a cross-section of which is shown in Fig. 8. A coal bunker was built on the inboard side and a small ash bunker on the outboard side of the boiler. Next to the coal bunker was built a storeroom for bolts, nuts, small brass castings, hand tools, pipe fittings and numerous other small parts and equipment for the power tools.

The arrangement of machinery and shafting is clearly

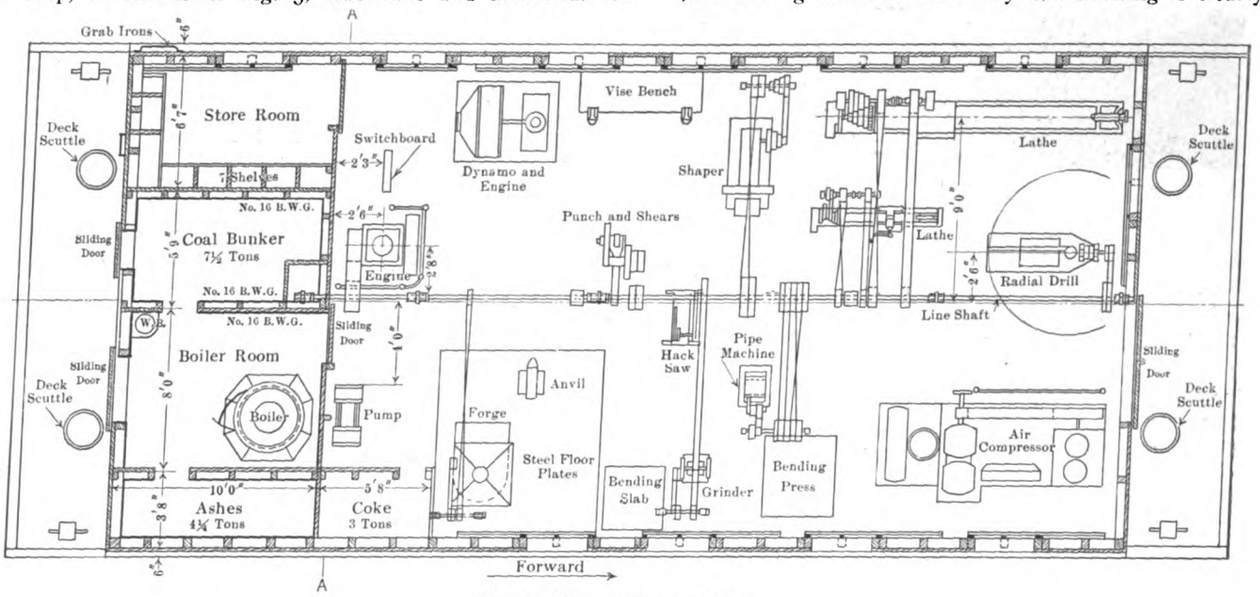

Fig. 4.—Plan of Machine Shop

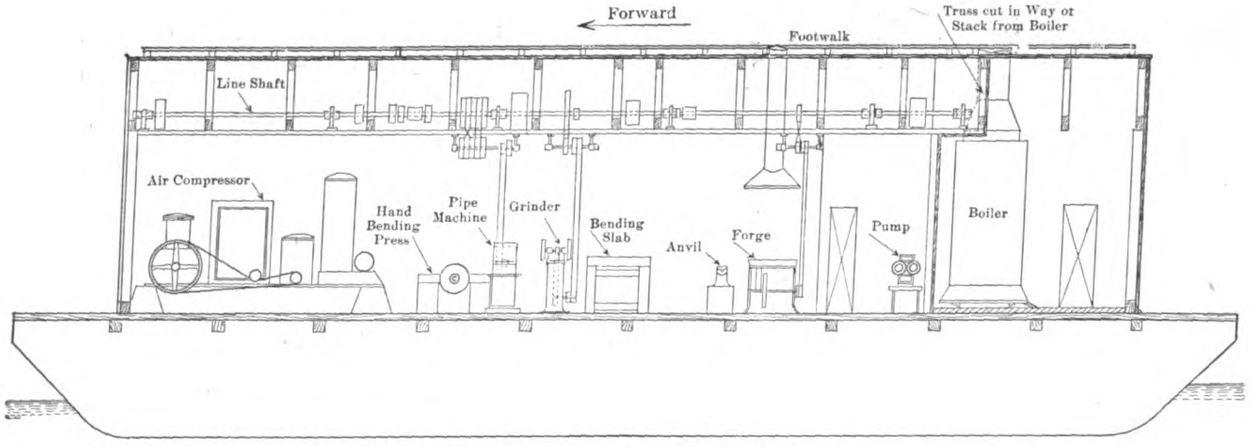

Fig. 5.—Elevation on Centerline, Looking to Starboard

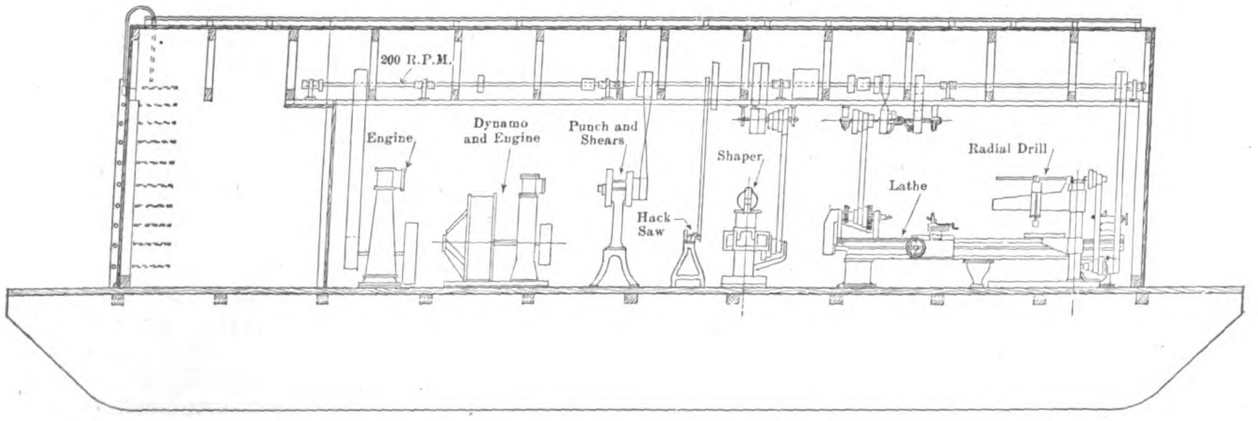

Fig. 6.—Elevation on Centerline, Looking to Port

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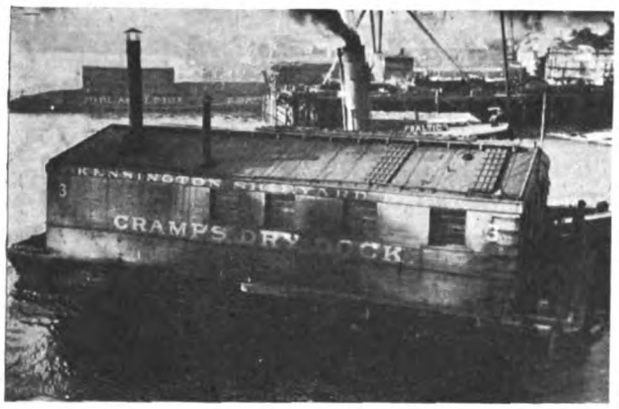

Fig. 7.—Exterior View of Barge

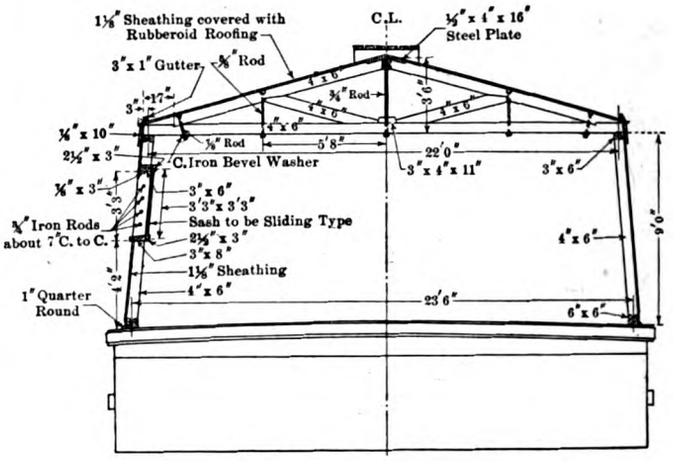

Fig. 8.—Section Showing Scantlings of Superstructure

shown in Fig. 4. The 8-inch by 8½-inch vertical engine is rated at 15 horsepower at 200 revolutions and is of sufficient power to operate all the tools at one time. The 8-kilowatt generator, run by an independent 5-inch by 5-inch vertical engine, supplies light for the shop and temporary lights to the ship undergoing repairs. The rated capacity of the air compressor for operating pneumatic tools is 140 cubic feet of free air and is run by a gasoline (petrol) engine mounted on the same base as the compressor.

In addition to the above, the shop is also equipped with the following tools:

One 30-inch radial power drill, capacity 1¼-inch hole.

One crank shaper, 21-inch stroke with 16-inch vertical adjustment.

One heavy-duty screw-cutting engine lathe, 24-inch swing, 119-inch centers and 14-foot bed.

One 13-inch screw-cutting engine lathe, 45-inch centers.

One power hack saw, capacity 5 inches by 5 inches.

One power punch and shears capable of punching ½-inch hole in ⅜-inch plate or shearing 1½-inch by ¼-inch bar.

One power pipe-cutting and threading machine, capacity 1-inch to 4-inch pipe.

One power floor grinder with two emery wheels each 12-inch by 2-inch face.

One portable electric grinder with two 8-inch wheels.

One blacksmith forge with hearth 32 inches by 45 inches and fitted with a power blower.

One straightening plate 3 feet square.

One hand-bending press; size of table, 3 feet 6 inches by 4 feet.

One horizontal duplex pump, 6 inches by 4 inches by 6 inches, for feeding the boiler, pumping out bilges and fire purposes.

The shop is also equipped with the necessary work benches, vises, anvil, pipe racks, overhead trolleys and supplies that you would expect to find in a shop on shore fitted with the tools mentioned above.

When there is no need for the floating shop away from the shipyard it is then used as an auxiliary to the machine shop, thus becoming a valuable addition to the equipment of the shipyard.

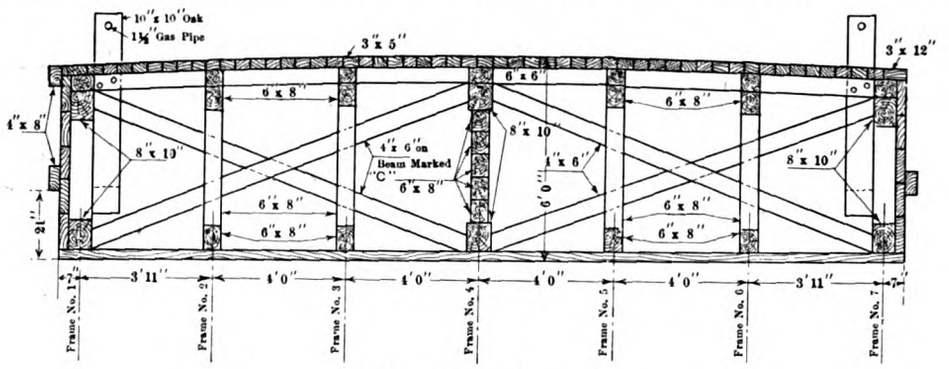

Fig. 9.—Midship Section

Quick Delivery Gains Orders for American Yard

COMMENTING on the order placed by the Eagle Transport Company with an American shipyard for four tankers, the British paper *Shipbuilding and Shipping Record* says:

"In announcing the contract, the vice-president of the Standard Shipbuilding Corporation said that the average price asked by British shipbuilders was £40 to £45, and the American price $196 per ton deadweight. At the old rate of exchange this would mean that the Eagle Oil Company were paying £40 a ton, but owing to the present exchange they were paying £58, subject to variation according to the rate of exchange when payment will be made. It is apparent, therefore, that the price was not the deciding factor, but the earlier delivery which was promised by the American shipyard. The placing of this order recalls the orders placed by the Federal Line in 1913 for a firm of French shipbuilders, in which transaction also the question of delivery was the deciding factor. British yards are exceptionally busy at present and adequate supplies of steel are becoming increasingly difficult to obtain within reasonable time. This applies especially to steel plates."

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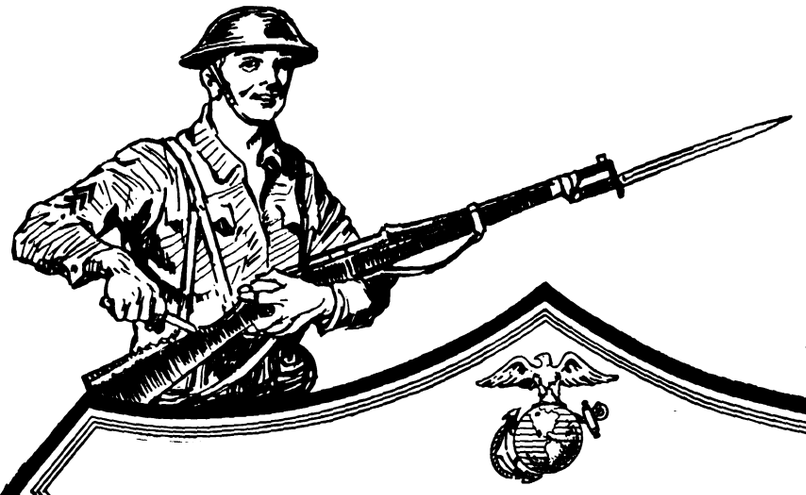

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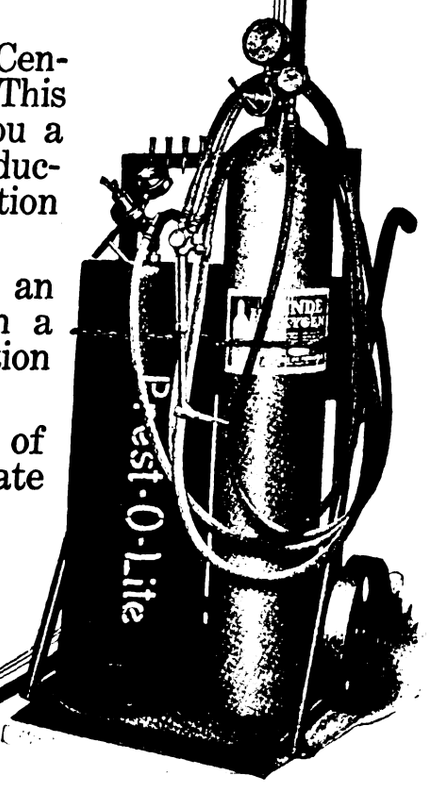

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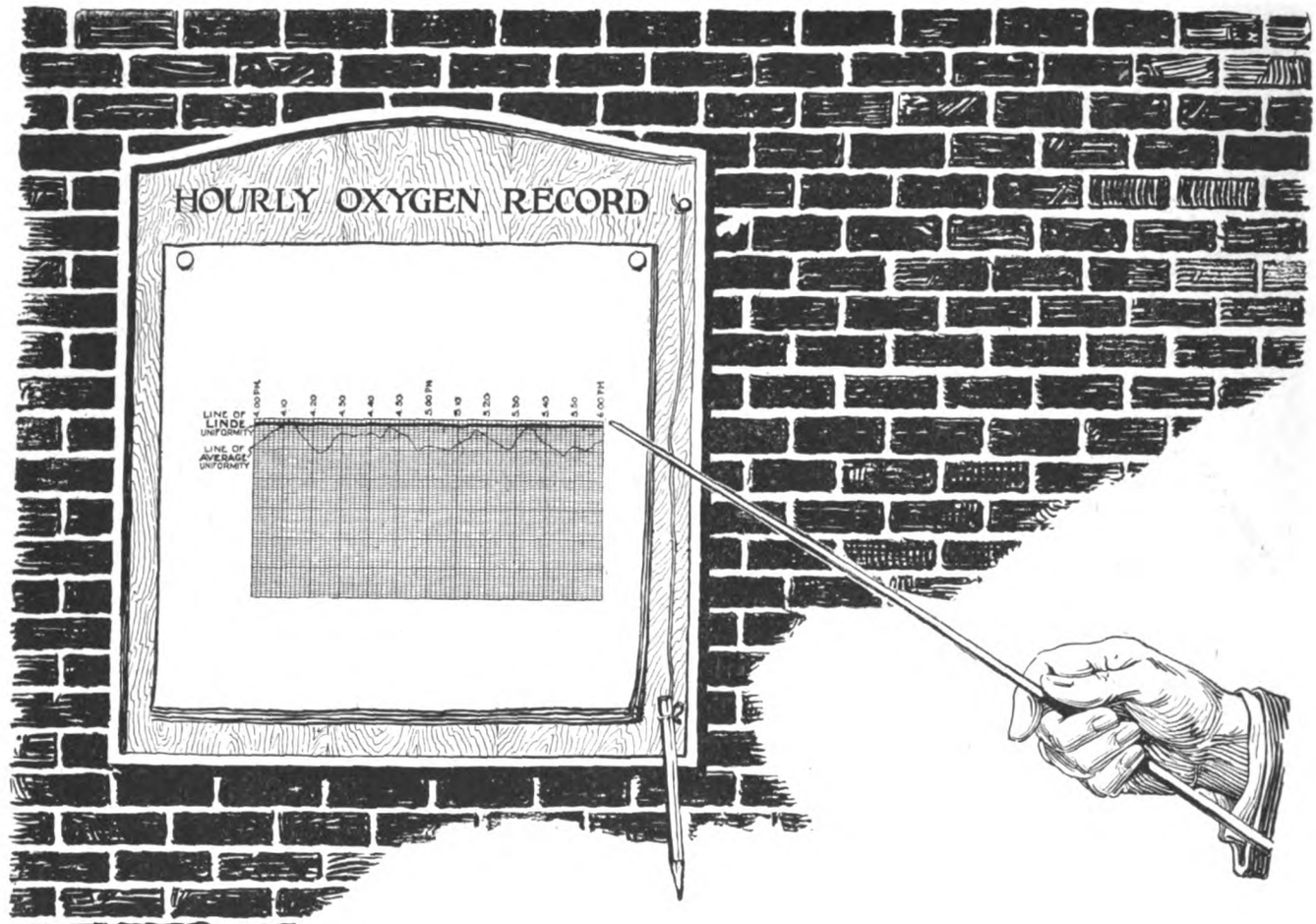

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The Commonwealth Dry Dock at Boston

A magnificent dry dock, the largest in the world and one of the finest pieces of engineering in the whole country, is the latest adjunct to the modern shipping facilities of the port of Boston. Although much work still remains to be completed in connection with this project, including the building and equipping of shops, storehouses and other accessories as an essential part of the plant for repairing vessels, nevertheless the docking of the United States battleship Virginia on December 22 marked the official opening of the new dock and signified to the shipping world that Commonwealth dry dock is ready for business.

COMMONWEALTH dry dock, constructed by the state of Massachusetts at a cost of more than $3,000,000 (£630,000), was one of the several big features conceived and planned by the old Directors of the Port of Boston and carried to completion by the Commission on Waterways and Public Lands, when the former was abolished and its functions absorbed by the commission under the able chairmanship of Hon. John N. Cole, the gigantic task being supervised from start to finish by State Engineer Frank W. Hodgdon, with Assistant Engineer John N. Ferguson in charge of construction.

It was expected that the dry dock would be completed some time ago, but, like many other large undertakings, work was greatly retarded by the world war, with the result that for some four years this great work of concrete and granite has gradually been growing and shaping itself into its intended form, until it now stands complete.

Although planned and constructed by the state, the world war did more than delay the work on the big structure—it attracted the attention of naval authorities to the government's need of such a dry dock, particularly for docking a damaged battleship. It was not long before the national government was negotiating for it, with the result that the dry dock, with a considerable section of land adjacent thereto, was disposed of to the government for $4,100,000 (£840,000), with the understanding that it was to be used for both naval and commercial purposes.

No better place in Boston harbor—and, for that matter, in any harbor—could be secured for such a structure, for, in addition to being in close proximity to the city proper, it is within a stone's throw of the main ship channel. Furthermore, its entire length rests upon a slate ledge—

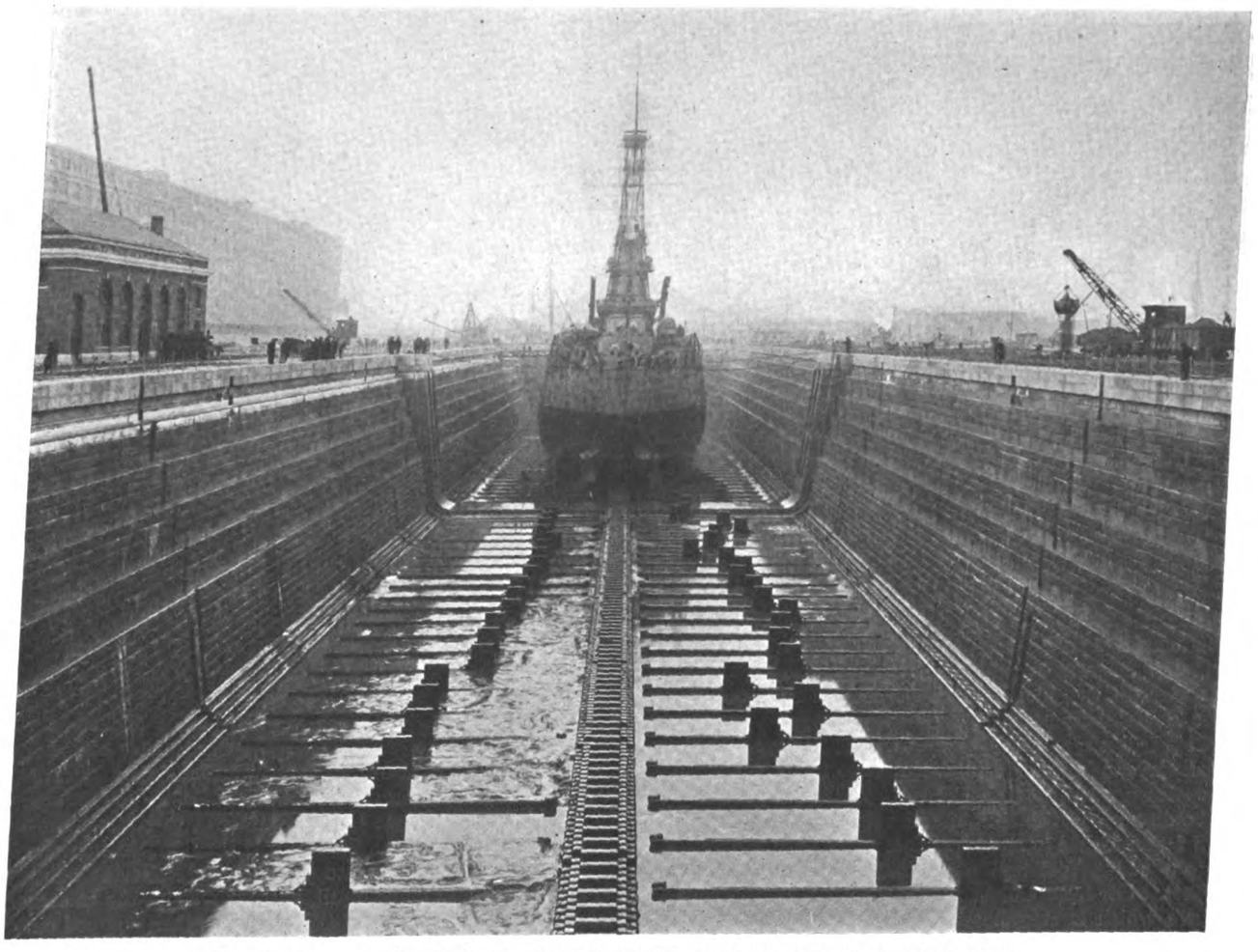

Fig. 1.—Commonwealth Dry Dock. U. S. S. *Virginia* Berthed in Inner Section of the Dock

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in fact, a large section of it is actually dug into the ledge. With its floor and dock walls resting upon this solid foundation, the walls are of mass concrete, lined with granite block. Its overall length is 1,200 feet, while the measurement between the copings of the side walls is 149 feet. The width at the entrance section is 133 feet at the coping, with sides sloped on one to eight batter, which gives a width at the elevation of the top sill of 120 feet. There is a depth of 35 feet at mean low water and 45 feet at mean high water at the entrance sill.

Owing to the great length of the new dry dock and the knowledge that it would be called upon to serve craft other than the largest now afloat and to do this economically, the dry dock was designed with an intermediate sill, as a part of the dock structure, the dimensions being similar to the entrance section.

Fig. 2.—Commonwealth Dry Dock Under Construction, Showing Method of Placing Granite Facing on Interior Walls

With the caisson in position at this sill the dock is divided so that the length of the inner section is 668 feet from the inner end to the intermediate sill, while the other section is 520 feet long. Through this arrangement it is therefore possible to dock one ship of 1,140 feet, or, with the caisson in place at the intermediate sill, two ships, one of 635 feet in the inner section and one of 490 feet in the outer section.

This caisson, which is of the hydrometer type, is practically a ship in itself, and, when performing its function, occupies a position where it rests against a granite sill, extending along the bottom and sides of the dock. It is 138 feet 6 inches long and 27 feet wide, with a maximum height of 53 feet and a minimum draft of 28 feet 5 inches. Concrete ballast fills the bottom of the caisson, above which is the chamber for water ballast, which is admitted according to the varying conditions of draft.

Over the ballast tanks is the operating or main deck, which is made watertight, but with three hatchways, one being the large machinery hatchway, which provides an opening from the upper deck to the bottom of the caisson and the other two are small inspection hatchways. On this deck are located the 60-horsepower motors for the pumps, the operating platform, the electric switchboard and the float gage, which indicates the depth of water ballast, as well as the inclinometers, which indicate the trim of the caisson. A 200-foot, flexible, armored cable connects the caisson with a specially designed outlet box on the dock wall, which carries a 440-volt current to it from the pump house which operates the motors, and like provision is made for supplying electric lights.

There are two 10-inch pipes on either side of the caisson for supplying water ballast, and, though they discharge free to the interior of the caisson, each is controlled by two gate valves, one of which is of the quick-closing type. For discharging the water ballast, two 20-inch volute centrifugal pumps of the vertical shaft type are provided and discharge at either side of the caisson. Each is provided with a five-port foot valve on suction, a motor gate valve at the pump discharge, and a flap valve at the end of the discharge pipe just outside the shell of the caisson. Its operation is simple. When a vessel is to be docked the dry dock is filled to the same level as the water outside, the caisson is relieved of sufficient water ballast by its own pumps until it floats at a suitable draft. It is then moved from the dock entrance by lines attached to electric capstans on the dock wall. The ship is then floated into the dock, the caisson drawn into position, and sufficient water ballast allowed to enter, until, with its weight, the caisson rests in position on the sill. The dock is then pumped out and the vessel is in position to be inspected.

Although the apparatus for filling and draining the dry

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dock is extensive, it is of the most modern type, and therefore the least complicated. There is one conduit 14 feet wide and 15 feet high, of arch section, which extends from the outer end of the dock to a point in front of the pump house, a distance of about 430 feet, and which is designed as the discharge conduit, receiving water from the main pumps. It acts as a filling conduit in the reverse operation by emptying through two sluice gates, each 6 feet by 8 feet, which are located in the conduit directly opposite the discharge from the main pumps. These gates discharge into filling chambers, which act also as diverting chambers, and connect with four conduits, leading out to the under side of the dock floor. One filling sluice gate fills into the two conduits which lead to the outer section of the dock and the other to the two conduits extending to the inner section beyond the intermediate sill.

Fig. 3.—Interior View of Main Deck of Caisson, Showing Gate Stands in Foreground, Switchboard at the Left, Motors Amidships, with the Main Hatch Directly Beyond

During the process of pumping out the dock, the same four conduits become drainage conduits, and they extend to a common suction chamber. Each, however, is provided with a separate sluice gate 6 by 8 feet, so that it is possible to shut off any particular one or any number from the suction chamber. All are controlled by oil-operated hydraulic cylinders 19½ inches in diameter, in a special chamber outside of but connected by a passage to the pump well, the pressure used to operate them being 300 pounds per square inch.

Like the rest of the appurtenances, the pumping plant is thoroughly modern. It comprises three main pumping units, two small drainage units, one sump pump and two oil pressure pumps, all but the latter being of the vertical shaft type, each consisting of a volute centrifugal pump, direct-connected to an electric motor. The main dry dock pumps have a 54-inch suction and discharge, each being operated by a constant speed electric motor of 1,250 horsepower. The suction of each pump is connected directly, without a gate valve, to a separate concrete conduit extending to the common suction chamber. The discharge from the pump connects to a check valve of special design of the butterfly type, beyond which is located a 54-inch gate valve operated by a hydraulic cylinder, giving an increase from 54 inches to 60 inches diameter, the size of the large cast iron pipe which delivers the water to the main discharge tunnel. An oil dash pot serves to cushion the operation of the check valve, connected by piston rod and crank to the shaft of the flapper. The pump impeller is 71 inches in diameter and is of cast iron. The pump is so placed in the well that its centerline is at an elevation of 9.5 feet above the floor of the dry dock. The motor of the pump is located on the main floor of the pump house, 55.5 feet above the dock floor, or one foot higher than the coping of the dock and 46 feet above the pump. It is of the constant speed induction type, with a speed of 240 revolutions per minute. The total weight and thrust of the pump impeller, shaft and rotor of motor are sustained by a spring-supported thrust bearing, the rubbing surfaces of which are constantly in a bath of oil.

One hundred thousand gallons per minute is the guaranteed capacity of each main pump, and the combined average overall efficiency of the pump and motor is 56.5 percent. A slight excess in both of these figures is shown by official tests. Operating together, the three pumps are capable of unwatering the dry dock in from two and a half to three hours.

Of the same type as the main pumps are the two small drainage pump units, having 15-inch suction and discharge openings. They are principally for draining the dock floor and conduits underneath which lead to the common suction chamber. A 20-inch pipe controlled by a hand-operated

The contractor for the construction of the Commonwealth dry dock itself and the pump house was the Holbrook, Cabot and Rollins Corporation, Boston and New York. The Weiss Construction Company, Boston, Mass., built the pump house, while the Donnelly Iron Works, Inc., supplied the interior stairways and guide-gearing supports for pump shafts. The Worthington Pump and Machinery Corporation, New York, furnished the pumping plant, and the electrical apparatus was furnished through that company by the General Electric Company, Schenectady, N. Y. The Chapman Valve Company, Indian Orchard, Mass., through the pump contractor, furnished the gate valves of the plant. The sluice gates of the dry dock and caisson valves were manufactured by the Coffin Valve Company, Boston, Mass. The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., built the caisson. The caisson pumps were furnished by the Worthington Pump and Machinery Corporation, as sub-contractors, and the electrical apparatus sublet to the General Electric Company. The Wellman-Seaver-Morgan Company, Cleveland, Ohio, furnished the electric capstans and the General Electric Company the electrical work, while the hand-power capstans were furnished by the Dake Engine Company, Grand Haven, Mich. The Whiting Foundry and Equipment Company, Harvey, Ill., furnished the traveling bridge crane, and power circuits for caisson and capstans were installed by Irving L. Matson.

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gate valve runs from the bottom of this chamber to 15-inch branch pipes with a hand-operated gate valve on each pump suction. The discharge of each pump is connected through a 15-inch gate valve, operated by hydraulic oil pressure cylinders to the common 20-inch discharge pipe, which contains a four-port check valve and extends outside of the pump well in the masonry of the dock wall to the outer end of the dock and is wholly independent of the main discharge conduit. The 20-inch suction pipe mentioned above connects by means of a Y-branch and hand-operated gate valve to the bottom of the main discharge conduit, so that this may also be pumped out, after placing stop planks in grooves provided at the outboard end. There is also provided a 20-inch tee branch supplied with a gate valve and suction pipe for pumping out the pump well itself in case of emergency. The pumps are located 4.5 feet below the dock floor, and their motors are on the main floor of the pump house, 60 feet above. Each of these motors is rated at 150 horsepower, having a speed of 600 revolutions per minute, operating on 3-phase, 60-cycle, 440-volt current. The type of thrust bearing is the same as for the main pump motors. The guaranteed capacity of each drainage pump unit is 6,400 gallons per minute, and the combined average overall efficiency of the pump and motor is 52.0 percent. Official tests indicate an excess of each of these figures.

In addition to this equipment for operating the dock proper, a small 3-inch centrifugal pump is installed in the sump at the bottom of the pump well, 72 feet below the pump house floor, for removing the seepage into the pump well. The discharge from this pump connects into the discharge pipe of the 15-inch pumps. This pump is controlled by an automatic switch, which is operated by a float in the sump chamber.

Five electric capstans of the most modern type form a part of the dry dock's equipment, two being located on either side of the dry dock and one at the inner end, for use in berthing and unberthing vessels. The one located at the inner end of the dock is for hauling vessels in. The other four are located so that one pair serves the inner and one pair the outer sections of the dry dock, or, if need be, any or all can be operated at the same time. These capstans are operated by 250-volt direct current, which is taken from the pump house installation, the alternating current there being converted by a rotary converter and carried in a loop circuit completely around the dock. This circuit is provided with special junction boxes at manholes in the dock wall, so that connections may be made for direct-current service to the capacity of the converter.

In addition to the electric capstans, there are six hand capstans, three on each side of the dock, as well as 32 cast iron bollards. These are so spaced between the capstans that one is located on either side of the dock at about 60-foot intervals.

In the construction of the dry dock, consideration was given to the possibility of additional equipment in the future, and, with this in mind, the masonry of the dock wall, as well as that of the pump house, was liberally provided with ducts for electric cables, openings for water and air pipes, etc., so as to enable the introduction of additional electric and compressed air equipment for working on vessels in the dock.

Located about opposite the intermediate sill of the dock, and setting back from the dock wall some 50 feet, is the pump house, in which is housed all the main equipment for supplying power, etc., for the operation of the various pumps, capstans, etc., of the dry dock itself, and, like the dry dock, its foundations are embedded in the slate ledge.

It is a brick structure with granite trimmings, well lighted from all four sides, with the main entrance facing the dry dock and midway in the building itself. Windows and entrance are of the arched type, reaching close to the eaves. The heavy equipment is on the main floor.

A switchboard located upon a balcony above the main pump-house floor controls the electrical equipment. The operation of the hydraulic cylinders on the sluice gates and the valves of the main and drainage pumps is controlled at another board adjacent, thus affording centralized control for all apparatus. The power for operating the pumping plant is derived from 3-phase, 60-cycle, 13,800-volt service supplied by the Edison Electric Illuminating Company. From this 13,800-volt bus are taken two circuits through separate high-tension oil switches, one of which passes to a bank of three single-phase transformers, each of 1,250 kilo-volt amperes capacity, stepping down the high-tension supply of 13,800 volts to 2,200 volts required by the main pump motors. The other circuit passes to another bank of three single-phase transformers, each of 150 kilo-volt amperes capacity, stepping down the 13,800-volt supply to 440 volts required by the other motors of the pumping equipment, the caisson pumps and other uses at the dock.

Included in the miscellaneous equipment is a storage battery charging set for operating high-tension switches and relays; two triple-action plunger pumps with an accumulator to maintain an oil pressure supply system for operating sluice gates and gate valves; a 220-kilowatt rotary converter for supplying the five electric capstans, with direct current at 250 volts. There is also a 20-ton, hand-operated traveling bridge crane in the pump house for handling pumps and motors.

A feature in the pump house is the three recording water level gages by which the operator may be constantly informed during any operation of the dock as to the tide elevation and the water level within the dock. These also are on the operating balcony, one for tide level and the other two for water level in the inner or outer sections of the dock.

With a depth of 35 feet at mean low and 45 feet at mean high water at the sill, the Commonwealth dry dock can safely care for the largest vessels afloat or likely to be built for a long time in the future, and also for the largest naval vessels, however badly they may be damaged.

Some conception of the size of the project involved in the building of this dock can be obtained from the fact that in excavating, approximately 344,000 cubic yards of earth and 83,000 cubic yards of rock were removed. Approximately 180,000 barrels of cement were used to make the 120,000 cubic yards of concrete of the dry dock. In addition, a channel 1,800 feet long, from the dry dock to the main ship channel, was dredged, during which process 628,000 cubic yards of material were removed. Approximately 400,000 cubic yards of filling were used for the back walls.

Crude Oil Burning Marine Engine

A crude oil-burning engine of the surface ignition, low-pressure type is now being manufactured by the Jacobson Engineering Company, Inc., New York City. Unlike the Diesel, Hvid, or Brons type engines, the two-cycle surface ignition design does not require the high-compression pressures of 450 to 600 pounds, nor the air injection pressure of nearly 1,000 pounds, but operates at little above the pressure of the automobile engine. Ignition is obtained by means of a surface which, on starting, is heated externally by a kerosene (paraffin) blow torch, but which maintains its own heat while the engine is running.

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Financing the New Merchant Marine

Provisions of the Mortgage Bill—American Marine Insurance—Movement to Encourage Investment of Capital in Shipping—Attitude of the Bankers

BY WALDON FAWCETT

AS Congress has progressed in the consideration of legislation for the establishment of an American merchant marine, it has become more and more apparent that one of the truly vital problems bound up with this issue is that of the financing of the new merchant marine. Financing, as the term is here used, has not reference, be it explained, merely to the financial arrangements for the transfer of the governmental fleet to private ownership. That in itself is, to be sure, an important responsibility, and, as our readers know, much discussion has been devoted to the terms to be accorded shipping interests that desire to take over on the partial payment plan the tonnage acquired by the United States Government during the war.

Overshadowing this temporary problem, if it be so denominated, is that larger aspect of financing which involves the enlistment of financial backing for the ownership and operation of ocean-going vessels. Here the necessity is not merely governmental co-operation (though that is necessary as a means to the end), but the securance of generous support from the banking interests of the entire country and the muster of the general investing public. This last, in particular, is a formidable undertaking. Shipping securities must compete with other forms of investment in a field that is assiduously cultivated from the very fact that the United States has lately been transformed into a creditor nation. Worse yet, the American people have ceased, in more than half a century of neglect, to think in terms of shipping investment. Behold, then, the necessity for arousing the great body of small investors to the opportunities of the merchant marine as a source of profit as well as a gratification of pride and patriotism.

Evidence of the widening realization in the legislative branch of the Government that the financial element is most important in the upbuilding of an American merchant marine has been found lately in the action of the chairman of the committee on commerce of the Senate in seeking to have incorporated as a section of the general merchant marine act the provisions of what was originally known as the Mortgage Bill. This measure is designed to remedy some of the inequalities and remove some of the complications that have heretofore resulted from the existence of liens on vessels, and the suggestion that it be made an integral part of the basic legislation evidences the feeling that the issue is intimately bound up with the fundamentals of a mercantile marine policy.

As though the obvious points of contact were not enough, it has been disclosed latterly at Washington that this self-same consideration of financing the American merchant marine is likewise part and parcel of the problem of providing all-American marine insurance for the fleet that is to be. Talking to this text, Fields S. Pendleton, shipbuilder, shipowner and ship operator of New York, recently addressing the members of the Senate committee on commerce, said:

"The foundation for a successful merchant marine is a sound, steady and strong policy of safety and security to the investor. It matters not how much money there is in Chicago, Minneapolis, Jacksonville or New Orleans, you cannot secure it unless you can show that the investment is safe, and that it will pay a reasonable return. The safety of the investment depends upon the protection afforded by the insurance; therefore, insurance is absolutely essential to the upbuilding of the American merchant marine that will protect the investment, if the ship is lost, so that the investor may have his money back even with the low rate of interest. Wherever the insurance is controlled the ship is practically controlled. The two principal factors are investors and insurance, and they go hand in hand. You cannot get the investor without the insurance. We must have more insurance facilities in this country."

That the attraction to the new American merchant marine of capital seeking investment has direct as well as indirect significance for the shipbuilding industry no less than for shipping interests was hinted in conversations at the Capitol by Homer L. Ferguson, president of the Newport News Ship Building and Dry Dock Company. Analyzing with frankness the situation that confronts his industry, President Ferguson said: "The prospects for shipbuilding in this country depend largely upon merchant shipping. The present shipyards—certainly the ones that were in existence before the war—were dependent upon two factors: one, the small amount of coastwise shipping that was built, and the other the naval shipbuilding. Since the war the Navy Department has equipped a large number of navy yards to do the major part of its own building, so that the future of the shipbuilding industry in this country depends upon the merchant shipbuilding."

Answering a question as to what is necessary to encourage the upbuilding of a permanent, adequate American merchant marine, Mr. Ferguson said: "The building of ships depends on their successful operation and profitable operation by the purchaser. That is more so in this country than abroad, although some shipbuilding companies have undertaken the building of ships which they themselves will operate, or through their agents, but in general it depends upon the purchaser finding a remunerative employment for that ship. Of course, no business that has not that as a background can exist any better than we existed before the war, from hand to mouth, and building every kind of thing.

"It is assumed by some that things are going to be so different, following the war, that we can both build and operate in open competition without any preferential assistance of any kind for our own shipping. The experience, however, of a hundred years before the war, and the assumption that most business men would make, I believe, would be that when things quiet down again we are going to be in about the same condition of competition that we were before. In shipbuilding, such as we have done during the war—building a large number of ships of the same type for war purposes—we have departed a good deal from ordinary shipbuilding, where a ship is designed and built for special service, and it seems to me perfectly plain that unless the United States is prepared to adopt some kind of policy that will give preferential

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treatment to its own ships, built in the United States owned, operated and manned by Americans, we cannot look to anything very much better than we had before. In general, we have tried to operate a perfectly free merchant marine in a protected country, and it has not worked and it will not work."

Addressing himself to the essentiality of support from the investing public, the head of the Newport News yard said: "We must have shipping so that the investing public, the investors as a whole, are interested in the purchase of shipping shares. In that respect it is quite similar to the railroad situation. The question of credits, the question of raising money, the question of operating ships, depends upon the sureness with which the investor believes his money is invested and will yield him a fair return."

With rare discernment and commendable breadth of vision, Mr. Ferguson has sensed the influence that is likely to be exerted upon the creation of a place for shipping in the American investment market by the policy that the Government may pursue in disposing of its war-begotten fleet. He discounts the theory that the sale of the ships (if made with due regard for replacement value) will prove a menace to American shipbuilders, and holds instead that if the ships are busy and profitable to private owners more ships will be wanted by those same owners and by others who will follow them into this newly revealed investment field. Mr. Ferguson holds that if the Government gives assurance of a stable policy of preferential treatment for American ships it can be reasonably expected that private capital in the United States will absorb from 8,000,000 to 10,000,000 tons of American shipping within a year or two.

Summing up his conclusions with respect to the all-important financial side of the merchant marine proposition, Mr. Ferguson said: "There are men who are willing to take a gamble, but I do not believe that you have yet an atmosphere for the creation of a market for ships so that investors will be willing to put their money into it to make a real merchant marine. I do not think that at this time there are enough of us in the business to make a merchant marine, and what we want is a widely scattered ownership and a stability of value that will tend to create that ownership." Incidentally, Mr. Ferguson gave it as his opinion that we hear too much these days regarding the plain cargo ship, whereas, to use his words, "the real need in a merchant marine is, in my judgment, a ship that carries people as well as cargo." He holds that the first-class passenger ship built in a well-equipped shipyard constitutes a tremendous factor in developing trade with any country and that the passenger ship is especially important just now for the cultivation by the United States of the trade of South America.

The importance of the creation of a considerable body of qualified American ship operators as a prerequisite of any flow of American capital into the channels of merchant marine investment has been emphasized at Washington of late by Wallace Downey, the shipbuilder. Commenting on the encouraging outlook in this respect, Mr. Downey said: "The knowledge of shipping is gradually growing in this country. A lot of young men are developing rapidly. In 1913 or 1914 you could count the shipping operators on the finegrs of your hand, almost. But out of all of the upheaval there are men who have come along—bright, brilliant young men, and they are learning—and if the Government stands by and gives honest, intelligent co-operation, this proposition can be worked out." Mr. Downey holds that the profitable conditions that would make of vessel property a form of investment to attract American capital are essentially "a matter of intelligent management."

As the subject has unfolded in the discussions in committee session at Washington, there has been increasing recognition of the part that the bankers of the nation must play, if the investment capital of the nation is to be, to any adequate extent, mobilized for the support of the American merchant marine and the development of the shipyards that will stand behind an American mercantile fleet. Shipbuilder Downey, discussing this angle of the issue, remarked: "If there were some form of procedure possible in this nation so that one could go into a trust company or bank and secure a loan on a ship like we do on a house, it would give this whole thing a constructive motion at once. The great shipping of the British Empire is founded and fostered by the fact that the shipowner with 25 to 50 percent of the money that the ship is going to cost, goes to the shipbuilder, and the shipbuilder goes to the banker, and then the owner and the shipbuilder and the banker all get together by carrying 50 percent or 60 percent of the mortgage and they put the ships over one after another. The ship mortgage is a sound investment, and it is a lever by which they have built up their tremendous shipping trade."

It is by reason of intimations such as the above that the framers of national legislation are devoting so much attention to what are known as the "mortgage features" of the pending legislation. Vigorous representations on the same subject have been made to the commerce committee of the Senate by Robert Strange, representing the United States Steamship Operators' Association. Commenting on the need for better arrangements with respect to this angle of ship financing, Mr. Strange said: "In the vicinity of New York, at least, a ship mortgage at the present time is considered a joke. If a shipowner comes to borrow money, they either make him transfer title to the vessel as security or they make him put up collateral. Anything that will improve this situation and improve the financial service will be very beneficial, particularly to the operators." He went on to say that some betterment of conditions is precedent to the ownership and operation of large numbers of merchant vessels by private interests, no matter whether the vessels be acquired from the Government or obtained under contract from American shipbuilders. It is recognized by shipowners that it may be necessary to embody in the legislation to be enacted certain safeguards to prevent a shipowner from placing a fictitious mortgage on a vessel merely to defeat subsequent lienors, but it has been urged that care be taken that these provisions be not objectionable to bankers, and especially that there be incorporated no provisions that would affect the salability—that is, interfere with the assignment of a mortgage.

There is a feeling that the cause of enlisting permanent investment backing for an American merchant marine in private hands is likely to be furthered in consequence of the calling into consultation as advisers on a Shipping Board policy of seventeen nationally prominent men of affairs. Of the "business doctors" who, beginning in the middle of April, are regularly to advise on the method, price and terms for the sale of the Government ships to private owners only, Charles Dawes, of the Central Trust Company of Chicago, ranks primarily as a banker. However, many of the other members of the new advisory body have served on bank directorates, and almost without exception the selected captains of commerce have had experience in "selling" bankers on their respective propositions, as well as selling the consuming public, so that it is expected that this newly recruited group will be in a

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position to weigh all the elements of a permanent merchant marine policy with due regard for the enlistment of lasting and dependable financial support, widely distributed.

On this same financial equation which has received attention at the hands of so many of the shipbuilders and ship operators who have recently journeyed to Washington to give the Government the benefit of their suggestion, P. A. S. Franklin, president of the International Mercantile Marine, has sought to emphasize the importance of using the present Government-owned fleet as a means to cultivate popular interest in shipping investments, and especially to concentrate such interest as may be aroused upon the financing of regular lines of steamers. On this latter score, President Franklin, in discourse with members of the commerce committee of the Senate said: "The tramp business is a profitable business and it is a desirable business, but the commerce of the country, the great percentage of the valuable trade, such as the trade in manufactured articles, requires a regular service to ports."

Asked by Senator Ransdell what must be done to bring the American people back into the shipping business and to persuade them to think in terms of shipping investment, Mr. Franklin said: "You have to offer attractions. You have to offer inducements to capital to get into this business. What the United States wants today is a policy to create—a constructive policy to establish your shipping firms and your shipping houses who are anxious to get into the trades of the world on as sound a basis as you can and a basis as attractive as possible to capital, so that they can get capital to finance themselves. We should try to do something that is constructive and which is going to last."

The attitude of bankers with respect to shipping investments has been indicated in the conferences at Washington by William F. Collins, secretary of the committee on commerce and marine of the American Bankers' Association. This committee stands committed to a policy of cooperation with Governmental agencies in studying, formulating and recommending a safe and consistent plan of ship financing. However, to date it has given no concrete assurances as to what the banking interests of the country would do to encourage new shipping enterprises. However, if encouragement from banking quarters has been in terms of generalities, there have not been wholly lacking concrete suggestions of ways and means for placing shipping securities in the hands of the public. For example, there is the suggestion of Fields S. Pendleton that in the case of future construction American shipbuilders accept part payment for tonnage in bonds and that they in turn distribute these bonds to the interests from which they purchase material, with the alternative of placing the bonds with banking connections or in any quarter where they would be held as investments.

Stoke-Hold Efficiency—III

BY A. POHLMAN

ASSUMING that the reader has digested the previous articles on this subject and is therefore familiar with the use of the flue-gas analyzer we will proceed.

Let us assume a Scotch boiler installation operating under forced draft. How is the analyzer going to help us? First see that a U-tube, or, better still, a direct-reading draft gage, is attached to the blower outlet. Remember that the whole problem is one of getting the right mixture. There is a certain relation between the thickness of the fuel bed, if you are burning coal, and your blower speed, or the amount of opening of the valves supplying the burners and the blower speed, if you are using liquid fuel. We could compute theoretically the number of cubic feet of air necessary to burn a given quantity of fuel, but we are going to have our analyzer do this for us.

Having a draft gage and an analyzer, we drill a hole large enough to pass a piece of one-quarter inch pipe through into the smokebox door, about a foot above the top row of tubes and in the center, and insert a piece of pipe long enough so that one end is about midway between the tube sheet and the door, and the other end a

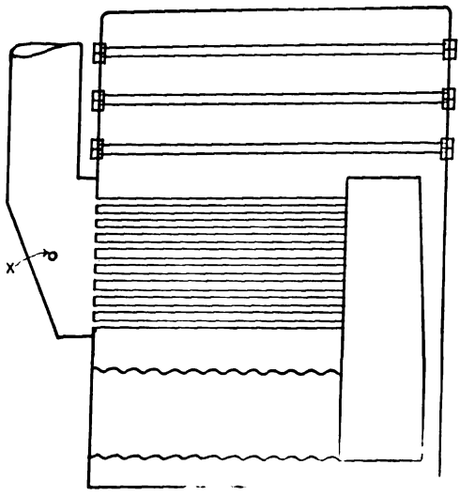

Fig. 1.—Scotch Marine Boiler. Cross Shows Where Gas Samples and Temperature Should Be Taken

few inches outside the door (see sketch). To this latter end attach the rubber tube which leads to the analyzer.

We are now ready to do some useful work. First level the fire (we are assuming a coal burner) and read the draft gage. Assume that it reads an inch and a half, and that our fire is ten inches thick. Drawing a sample of gas, suppose we find our CO_2 reading as seven percent. (Before proceeding, let me suggest twelve percent as the mark to aim at. I use twelve percent because experience

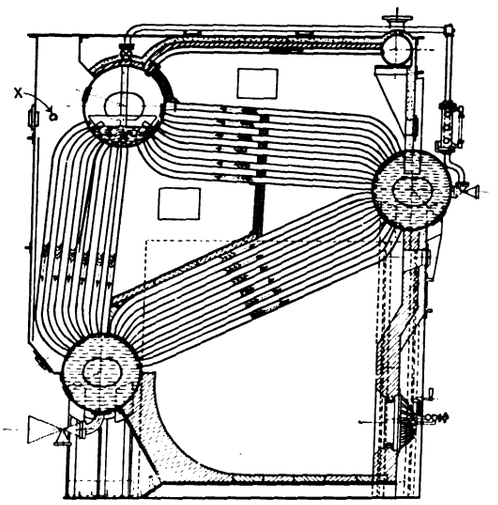

Fig. 2.—Watertube Boiler. Cross Shows Where Gas Samples and Temperature Should Be Taken

has shown that this may be considered a very good working average.)

Seven percent of CO_2 is low. We want 12. Why was it low? Low CO_2, while not always, usually is an indication of excess air, so we assume this to be the cause. By reducing the blower pressure to, say, one-half or 75 inches, and thickening the fuel bed to twelve inches, we

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find the CO_2 up to eleven percent. We now reduce the blower pressure to one-half inch, but leave the fire as it was, as this may be considered heavy enough. Again we analyze a sample and find our looked-for twelve percent. We now know that with that particular coal carried in a twelve-inch, fire-bed, one-half inch blower pressure is required. If the thickness of fire is increased, the draft or blower pressure must be increased. If the coal is changed, get busy again with the analyzer and establish the proper draft to fuel thickness as described above.

It is suggested that an hour or two be devoted to this work the first day out. Don't stop at a few samples. Take several dozen at different drafts and fuel thicknesses and make up a schedule, or, better still, a chart showing the various drafts required for various fires. Hang this up in the engine room. As a dependable guide, put a tapbolt in the fire-door liner at the point you decide is the proper height of fire.

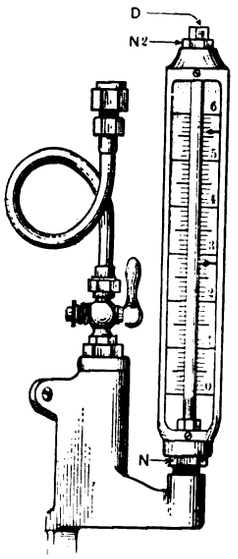

Fig. 3.—Hays Direct Reading Gage. This Type of Gage Displaces the V Gage and Can Be Read at a Glance. It May Be Used for Pressure or Vacuum Within Its Scale

Fig. 2 shows a watertube boiler and the cross indicates the point at which to collect the sample. Remember that in any installation the place to take a sample is at the point where the gases leave the heating surface of the boiler. Before arriving at this point the gas has not completed its work and given up its entire heat. After this point is passed the gases do not interest us. In the case of the watertube installation, should the percentages be uniformly low and no variation appear when the fire-doors are opened and closed, it will indicate short circuiting of gases, due, probably to broken down baffling. A pyrometer inserted in the different passes through the dusting slides will usually indicate which baffle is damaged. There is a decided drop in temperature from one pass to the other, if the baffling is in good order.

On oil-burners, this type of installation is handled the same as regards the gas analysis, as on the coal burner, with the exception that instead of playing with the fire-bed we use the valves that supply the burners. It will usually be found that a very light touch of the handwheel will make a decided difference. It is suggested that a marker plate of light sheet metal be fastened to the stuffing-box nut of the valve and the handwheel marked. The graduations on the plate should be pitched at, say, an eighth of an inch. The pump pressure should remain constant. It might be added that when burning oil it will be found that a light brown haze comes from the stack when the highest percentages of CO_2 prevail. Should no means of analyzing flue-gas be found aboard a ship burning oil, try to secure this stack effect. A perfectly clean stack usually indicates a fuel waster.

Where natural draft is used with an oil-burner the links in the damper-chain should be numbered, or, if a quadrant and lever are used, the quadrant should be marked.

Water tenders should be impressed with the fact that a blower running like mad and sending up a shower of sparks does not mean steam but furnace repairs and blower breakdowns. If a large volume of air is supplied, the fuel must be supplied to absorb it. In coal burning, there is a limit to the number of pounds per square foot of grate surface that may be consumed.

Where it is possible to secure them, direct reading draft gages should be used. At the best a U-gage is unhandy to read and particularly when it comes to dark corners a water tender is apt to be human and guess. Another eye-sight-saving scheme is to put a few drops of Japan white in the water in the leveling bottle of your analyzer. This remains in suspension and has no effect on the gases, while the analyzer scale will stand out clearly and can be read with greater ease.

(To be continued.)

The Largest Shipyard in the World*

New Boilers Installed

Two additional Babcock and Wilcox boilers, each of 266½ horsepower, were first installed at the south end of the old power house with high settings; that is, 10 feet from the floor to the under side of the tubes, thus giving increased combustion space, eliminating smoke and increasing the economy. Jones underfeed stokers were also installed under these boilers to secure better combustion of fuel and a reduction in labor for carrying increased load that had developed. This arrangement proved satisfactory in every way and was adopted as a standard for future installations.

In the new extension which was added to the power house, six Keeler watertube boilers of 400 horsepower each were installed. These were equipped with high settings, Jones underfeed stokers, overhead Berquist coal bunkers with Link Belt coal crushers and conveyors, so that the fuel can be dumped directly from the cars into track hoppers and crushed, conveyed and stored in overhead bins, whence it feeds by gravity to the hoppers on the top of the stokers at the boiler fronts. This arrangement eliminates all labor as regards hand firing, the amount of labor saved being two firemen and two coal passers per watch of eight hours.

At the rear of the boilers two new Cameron two-stage turbine-driven centrifugal feed pumps were installed along with a Cochran feed water heater which automatically measures the entire amount of feed. There was also installed two Permutit water filters of very large capacity for filtering the entire feed water required for the power house. This was found necessary, as the feed water is taken from the Delaware river and at certain times of the year is filled with sediment, which causes a great deal of tube trouble in the boilers. The filters have entirely eliminated this trouble and reduced the repair bill at least 75 percent. These boilers are also equipped with Bayer's soot blowers for cleaning the soot from the outside of the tubes.

A triple combination draft gage is installed on each boiler to show the draft over the fire at the stack and in the blast pits. General Electric steam flow meters are installed on each boiler for indicating the flow of steam

* Concluded from April issue.

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from each unit and are used to equalize the load between each boiler. Coal counters are also installed on each stoker, which have been carefully calibrated, from which the coal readings may be taken at any period desired.

Automatic CO_2 recorders with gas collectors are also connected for maintaining high combustion conditions. Besides this, pyrometers for watching the temperatures of the stack gases, and in fact everything that would lend itself to high operating economy, was installed and is used, with the result that the plant is now operated with an average evaporation of about 10½ pounds of water per pound of coal from and at 212 degrees Fahrenheit.

The new boilers are connected to a radial brick stack of the same dimensions as the stack already mentioned by means of a steel flue which is swung very high in the boiler room. This is lined with 2 inches of special vitrobestos material, which eliminates the waste of a considerable amount of heat which would otherwise be radiated from the ordinary brick flue.

It is intended, when improvements which are now being made are completed, to eliminate the present coal trestle and bankers in front of the fire room and also to utilize the present coal conveyor as an ash conveyor, openings having been placed in the floor in front of each boiler, so that when the fires are cleaned the ash and clinker can be emptied right into these openings and conveyed to overhead ash bunkers, whence they can be emptied directly into railroad cars or trucks as desired.

Engine Room Extension

Two 2,500 kilowatt, high tension, alternating current, 2,300 volt General Electric turbines, one 600 kilowatt, high tension, alternating current, 2,300 volt General Electric turbine and one 1,250 Allis-Chalmers turbine generator have been installed along with one turbine-driven exciter of 25 kilowatts capacity and three motor-driven exciters, two of which are of 50 kilowatts capacity and the other of 9 kilowatts capacity. There is also one 500 kilowatt rotary converter installed in the engine room, along with a modern up-to-date switchboard.

At the south end of the engine room two Ingersoll-Rand air pumps are installed along with the batteries, controlling gear and recording tapes for the Gamewell fire alarm system, which has been installed throughout the yard.

Under the engine room there is a basement in which, on the west side, is located a high tension wire vault. There is also a main with air intake for ventilating the high tension generators. These units discharge the hot air in the basement. On the east side, there is installed a 52-inch main exhaust pipe with outlets and special exhaust valves to each unit. These exhaust valves, which are 48 inches in diameter, are so arranged that they can be operated by hand, which, of course, is a very slow process, and also by electric power with a push button. This exhaust pipe leads outside to a Bayer barometric condenser, which is guaranteed to maintain a vacuum of 28 inches with the circulating water at 70 degrees Fahrenheit and 100,000 pounds of steam being supplied per hour. The injection for this condenser is supplied from two Cameron motor-driven centrifugal pumps of 8,000 gallons capacity each, the motors being high tension, 2,300 volts, located in the new pump station known as the *T* and *U* pumping station. The distance from this pump station to the condenser is a little over 1,400 feet, the size of the supply pipe being 24 inches in diameter.

In conjunction with this condensing outfit a duplicate unit is also installed to take care of the reciprocating end of the power house, having a duplicate set of air pumps.

It was also necessary to provide and construct a new pumping station at the head of the wet slip some 600 feet away. Two pumps were installed, one of 4,300 gallons per minute capacity and the other of 6,000 gallons per minute capacity.

It was found necessary to increase the general water service and fire systems, one system being used for both purposes. Accordingly, the new pump house, known as *T* and *U* pumping station, was built on the river front at the head of one of the wet basins. This building is of fireproof construction, being built of reinforced concrete, brick and steel. The roof is of a slab concrete construction.

Fire and Water Service

Provisions were made for three high-pressure fire and general water service pumps and three low-pressure water service pumps, two of these being installed at the present time to serve condenser No. 2 of the power house. Each low-pressure unit is of 8,000 gallons per minute capacity under 25 pounds pressure with single-stage Cameron centrifugal pumps driven with high-tension, direct-connected, 2,300-volt motors. Two high-pressure pumps, also of the Cameron make, were also installed in this station, each of 1,500 gallons per minute capacity against 110 pounds pressure. They are also driven by direct-connected, high-tension, 2,300-volt motors. Inside along the west side of this station is a 20-inch-diameter main suction header connected to three separate suctions which run outside and into the river. Each suction is equipped with sliding strainers so that they can be cleaned readily. The header and suctions are piped up in such a manner that any one, two or three can be used at the same time.

These high-pressure pumps discharge into a common underground general water service and fire system, which is also looped in and connected with a duplicate pumping station built on Newton Creek in the South Yard. The new part (south end of yard) has been laid out by means of underground valves and street boxes so that parts of this system can be shut off at any time in case of break, repairs or additional connections. The main is 12 inches in diameter, being of class "D" Bell and Spigot cast iron pipe.

There are also four fireboat connections on as many piers in the North Yard. Each connection has three outlets, so that three 3½-inch hose lines can be connected from the fireboat. This furnishes four sources of water supply for fire protection, namely, one from the three original Underwriters' fire pumps, one from the *T* and *U* pumping station, one from the South Yard pumping station, and in case of these failing there still remain the three fireboat connections.

Since 1918, due to the extension of the plant, about 30,000 lineal feet of fire and water service pipe have been laid underground and above ground in the North Yard.

Two Ingersoll-Rand air compressors were installed, each of 2,700 cubic feet per minute capacity for 100 pounds pressure. They were placed in what is known as *T* and *U* substation.

Torpedo Boat Destroyer Plant

This plant is of temporary construction, the buildings being mainly frame and, in some cases, frame stucco. The plant consists of ten ways (four open and six covered), a plate and angle shop, administration building (with miscellaneous offices and storerooms for various departments, also toilet and washrooms for the workmen), a special paint department, a large substation and galvanizing plant.

In the substation there are installed two Chicago

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Pneumatic air-compressors, each having a capacity of 3,600 cubic feet of air per minute at 110 pounds pressure; two triplex hydraulic pumps made by the Aldrich Pump Company, each having a capacity of 25 gallons per minute at 1,500 pounds per square inch pressure; one accumulator, also made by the Aldrich Pump Company, to control these pumps; two fuel oil pumps and two Wilbraham-Green blowers, each having a capacity of 1,360 feet per minute at 2 pounds per square inch pressure. These blowers were installed for the plate and angle, rivet heating and other furnaces required in the plate and angle shop. There were also installed four vertical coal-fired boilers, 54 inches in diameter by 11 feet high, carrying 125 pounds pressure, for supplying the necessary steam for testing, heating galvanizing, etc. All the above machinery is driven by direct connected, high-tension, 2,300-volt motors.

Electrical Equipment

The electric equipment in this station consists of two 350-kilowatt rotary converters with static transformers for lighting and an extensive switchboard.

Galvanizing Plant

The building containing the galvanizing plant is very large and well ventilated. In this there are three special tanks arranged in tandem constructed of heavy spruce planking. The galvanizing pot is placed some distance from these tanks. The tanks and galvanizing pot have a capacity for handling plates 7 feet wide by 26 feet long.

An unusual feature about this plant is that no oven or steam coils are required for drying plates. The process is first to dip the plates in a sulphuric acid tank, in which is a large agitator, consisting of a wooden plunger about 12 inches wide running the entire length of the tank. The mechanism is driven by an electric motor through worm and worm gearing to a shaft with rocker arms that link to this agitating plunger, the rocker arms being fitted with balanced weights. The plunger, working up and down, causes the acid to splash at a high velocity on the metal and, it is claimed, removes all scale and rust in a very short time. The plates are then emersed in hot, fresh water, and from there are dipped into a third tank containing a hot muriatic acid solution. Upon being taken out of this tank and brought out in the air, the plates dry off very rapidly. As no ovens are necessary to dry the plates, they are sent out to the other end of the shop, finished.

An overhead monorail system served with Shepard electric hoists of 2 tons capacity each, with floor control, handles all the material through this shop.

A system of special syphons and drainage was found necessary to take care of the emptying, washing, etc., of these acid tanks. Indicating and recording pyrometers are also installed on the galvanizing kettle, so that the metal will not be overheated or burned.

Plate and Angle Shop

The plate and angle shop of the destroyer yard being a low, one-story building, would not permit the installation of overhead traveling cranes. The equipment is as follows:

One double-ended angle furnace, capable of heating angles and channels up to 45 feet long.
One small angle furnace, taking work up to 6 feet long.
One plate-heating furnace, capable of taking plates 6 feet wide and 30 feet long.
Three double-ended rivet-heating furnaces, all being equipped with low-pressure oil burners.
One hydraulic joggling press, 150-ton capacity.
One 50-ton horizontal hydraulic cold press.
One 100-ton hydraulic lightening hole punch.
Two 80-ton hydraulic shears.
One Sellers plate planers for 30-foot plate.
One Southwark plate planer for 27-foot plate.
Two Long and Allstatter double-ended plate punches, 40-inch gap.
Two Long and Allstatter plate punches, 48-inch gap.
Four radial drills with 60-inch radius.
Three Post double countersinking machines.
One guillotine sheer, plate 48 inches.
Four 30-inch gap punches.
One notching machine.
Two 24-inch gap punches.
One pair of plate-bending rolls, 10 feet.

All these machines were equipped with the necessary tables, skids, etc., in addition to eight laying-out tables. In the angle shop are the following tools:

Eight No. 3 horizontal punches.
One single notching machine.
One double No. 2 angle sheer and turntable.
One straight No. 2 double-angle shear.
One angle planer.

There are also six double-jointed jib cranes, each of one ton capacity on the assembling floor.

This shop is also served with nineteen jib cranes of two tons capacity, having a jib 20 feet long and each equipped with an electric hoist, floor operated. These hoists were supplied by Sprague, Shepard and the Link-Belt Company.

Plate and Angle Shop No. 2

Plate and Angle Shop No. 2, 269 feet wide by 792 feet 6 inches long, consists of three bays, the west bay being the angle shop, the center bay the plate shop, and the east bay the plate storage space. The mold loft, 650 feet long, is built over the plate shop. This building is of modern construction, being mainly steel finished in stucco and built of brick.

In the plate and angle furnaces coal has been resorted to as a means of heating in place of oil. The reasons for using coal as fuel are, first, scarcity of the grade of oil fuel used in this yard (28 to 32 Baume oil); second, that 60 percent to 70 percent of the fires in the shipyards during the war was due to oil fuel, and, third, the coal-fired furnace, such as is used here, has shown an economy of one-half the cost of oil.

There are two angle furnaces; one will take angles and channels 60 feet long inside, and the other 30 feet inside of doors. The 60-foot angle furnace is equipped with eight small Dutch ovens; the 30-foot angle furnace with four Dutch ovens and four special Jones underfeed stokers. The plate furnace, 7 feet 6 inches wide inside, will take a plate 30 feet long between ends. This is equipped with seven Dutch ovens and seven special Jones underfeed stokers, four on one side and three on the other. This plate furnace is also connected to a stack with large plate-controlling dampers. The two angle furnaces are connected to one stack with separate controlling dampers.

These furnaces are designed to deflect the flame directly over the metal in the furnace, and the flame, passing down under the hearth, produces very easily the same heat both on the underside and the top, viz., 2,200 degrees F., and, if necessary, higher temperatures can be maintained. Angles 8 inches by 6 inches by 5/8 inch by 50 feet long are heated in the long-angle furnace in six minutes with a very soft bending heat. Plates 6 feet by 25 feet by 7/8

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inch thick are heated in the plate furnace in 22 minutes to a very soft bending heat; in fact, it is not possible for one crew on the slabs to work these furnaces to the maximum capacity. They prove very economical in fuel and very efficient in heating. When working these furnaces full capacity, a quantity of three pounds of metal to a pound of coal is shown. The long furnace averages on big material 14 tons for 24 hours.

ADDITION TO THE FORGE SHOP

An addition to the forge shop was also found necessary for handling heavy forges. A United Engineering Company's combination steam hydraulic forging press was installed having a capacity of 1,200 tons pressure and taking in ingots 38 inches square. Two special heating furnaces were designed to serve this press, one furnace having a single charging door to take in 38-inch square ingots, the charging door being 6 feet wide by 40 inches high, the other furnace having two charging doors of smaller dimensions. The furnaces are 10 feet wide inside.

These furnaces are heated by means of two Jones underfeed stokers of standard design, set in a special combustion chamber at the end of the furnace; the flame passing over a bridge wall enters the heating chamber, which has a roof arched in both directions. This arch, in a lengthwise direction of the furnace, falls to within about 18 inches to 2 feet of the hearth at the rear end, thus causing the flame to encircle the forge, which rests on the sill of the charging door and supporting wall in the center. This keeps the forging from the hearth of the furnace to a distance of 12 inches, allowing the flame free circulation under the bottom as well as over the top of the ingot. The combustible gases in the flame leave the furnace at the hearth at the rear end of the furnace and enter a flue which is built below the floor line and connects to a stack which has a separate lining and is guaranteed for a temperature of 2,000 degrees. A water-cooled damper is installed in each of these flues to control the draft.

A heat of 2,400 degrees F. is easily maintained in these furnaces. Sand-cast ingots 38 inches square and 10 feet long can be heated and soaked and ready to work in from 18 to 19 hours' time. After working, these heats can again be brought up ready to work in from 3½ to 4 hours' time.

A 35-ton Pawling and Harnischfeger overhead crane serves this press and furnace. This crane has swung on the hook a separate turning gear with flat-linked chain 10 inches wide, made by the Brown Hoisting Machinery Company for handling and turning the forgings. The crane and turning gear are entirely controlled on the floor of the forge shop adjacent to the press operator.

Additional extensions were also made on the forge shop at the east end by increasing the drop forge and small hammer departments. An addition to the original plate shop No. 1 was also found necessary, consisting of a new oil furnace of the same size and capacity as the one already described in plate and angle shop No. 3, with two Long and Allstatter double punches with 60-inch gap. These punches are equipped with Lysholm plate tables, and the necessary 5-ton jib cranes with hoists, etc.

In addition to the above, extensions were made to the general storehouse, plate storage sheds, etc.

A new power house and substation were built in the South Yard, the fire room being equipped with four Keeler watertube boilers, each of nominal rating of 400 horsepower with a steam pressure of 175 pounds. These boilers are equipped with underfeed stokers of the Jones standard type, fuel being hand-fired from the bunker into the stoker hopper. In addition to these four boilers, there are two large outside-packed plunger duplex feed pumps made by the Epping-Carpenter Company of Pittsburgh, a large Cochrane metering feed water heater, one Permutit filter, two spare injectors, Bayer soot blowers and all the necessary draft gages, gas analysis apparatus, flow meters, etc., for working these boilers efficiently. The boilers are connected to a radial brick stack 150 feet high by means of an overhead steel flue with vitrobestos lining 2 inches thick.

An hydraulic accumulator, 17 inches diameter, 10 feet stroke, is also located in the corner of the fireroom. On the other side of the division wall between the engine room and the fireroom are located two large triplex motor-driven hydraulic pumps of the Aldrich make, which have a capacity of 150 gallons per minute, 1,500 pounds pressure per square inch, automatic unloading attachment. There are also installed in this room two tandem compound duplex drinking water pumps, made by the Epping-Carpenter Company, also two small duplex fuel oil pumps, two Ingersoll-Rand motor-driven air compressors, each having a capacity of 3,600 cubic feet per minute, 110-pound pressure (provisions being made for a third unit, if necessary); two rotary converters, 500-kilowatt capacity each, are now installed, with a provision made for the third one, if found necessary.

There are eight 4½-inch artesian wells with a large receiving reservoir. These wells, although pumped automatically, can, however, be used as direct suction wells in case of air pressure failure. A complete underground system of fire and general water service lines, drinking water line, steam, compressed air and fuel oil lines is installed. This yard has two separate fireboat connections. The plate and angle shop is equipped with furnaces of the same types, size and design as those already described for plate and angle shop No. 2 in the North Yard.

The machine shop is heated in the same manner as the machine shop in the North Yard, by means of hot blast air recirculated over steam coils by means of forced draft fans driven by steam engines. The balance of the plant, including the offices, is heated by direct radiation when necessary.

All electric power required for the South Yard is supplied from the main power station in the North Yard, boilers being necessary to operate the forge shop to supply steam heat for testing purposes, etc.

For handling the material outside, the North Yard is equipped with eleven locomotive cranes and two locomotives, in addition to several small electric locomotives operated by storage battery. The South Yard is equipped with one locomotive and four locomotive cranes with several small electric locomotives operated by storage battery.

NORTH YARD EXTENSIONS

A separate substation was built to serve plate and angle shop No. 2. This contains two hydraulic pumps of 75 gallons per minute capacity each, 1,500 pounds pressure, electric driven; also one accumulator 15 inches diameter by 10-foot stroke, all made by the Aldrich Pump Company, Allentown, Pa. There are also two rotary converters, 500 kilowatts each, with statics for lighting and one switchboard.

There has also been provided a very large brick building, on the second floor of which is located kitchens, bakeries, etc., and cafeteria complete to feed between 2,000 and 3,000 men. On the first floor of this building is located the refrigerating plant, with meat boxes, etc., coils, fans, engines, etc., for heating and ventilating.

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The Largest Shipyard in Australia

BY JOHN O'TOOLE

Although Australia is still more or less a newcomer in the shipbuilding industry, construction in her yards has, within the last few years, practically made the Commonwealth independent of other countries in supplying the ships necessary to carry on her trade. The problems of obtaining materials and machine equipment for developing the existing shipyard facilities remained unsolved during the war, but extensions since then have been rapid. The development of the largest shipyard in Australia is typical of the expansion throughout the country. As late as 1913, Walsh Island, the site of the Government Dockyard, was merely a mud flat at the confluence of the northern and southern arms of the Hunter River, discharging into Port Hunter, upon whose shores the important coal distributing center of Newcastle is located. Since that time more than $2,425,000 (£500,000) have been expended in building up the island.

SOME years ago, in order to improve the depth of the harbor on which Newcastle, N. S. W., is located, extensive dredging operations were undertaken, and it was found necessary to dispose of the silt on a mud flat at the mouth of the Hunter River. Thus the foundations of an island were laid, which was later selected as the site of a repair plant for harbor dredges and other public works, when the Commonwealth Government took over the State Dockyard at Cockatoo Island, Sydney, for use as a naval dockyard.

It was necessary to develop this embryo island very extensively before it could be utilized commercially, and to this end sand pumps were set to work building up the land from adjacent sand banks. A double advantage resulted from this work, for the harbor channels were deepened at the same time that Walsh Island came into existence. In its final form the island covers an area of 600 acres, 100 acres of which are at present used by commercial enterprises. Prior to shipbuilding, the shops erected on the island were engaged in constructing a number of steel bridges for railroad lines that were being developed throughout the Commonwealth.

Before the Government decided to engage in building steel ships for trade purposes, a large bucket dredge with a capacity of 12,500 tons per hour, two steam harbor barges each capable of carrying 1,500 tons of silt and four steam trawlers were completed.

Facilities of Yard

The shipyard equipment consists of three large building ways, each 360 feet in length and 60 feet wide, solidly constructed on concrete foundations; one smaller building slip and two patent slips for docking vessels up to 600 tons.

The machinery is modern in every detail and sufficient to meet the requirements of any ship built in the yard. The overhead gear consists of two hammer-head cranes 67 feet high, with a radial capacity of 101 feet and a lifting capacity up to 4 tons. Several long-jib cranes are also installed for handling lighter materials.

The plate shop is a steel building 197 feet in length and 123 feet wide, well lighted and ventilated. The machines are placed in parallel rows along the length of the shop.

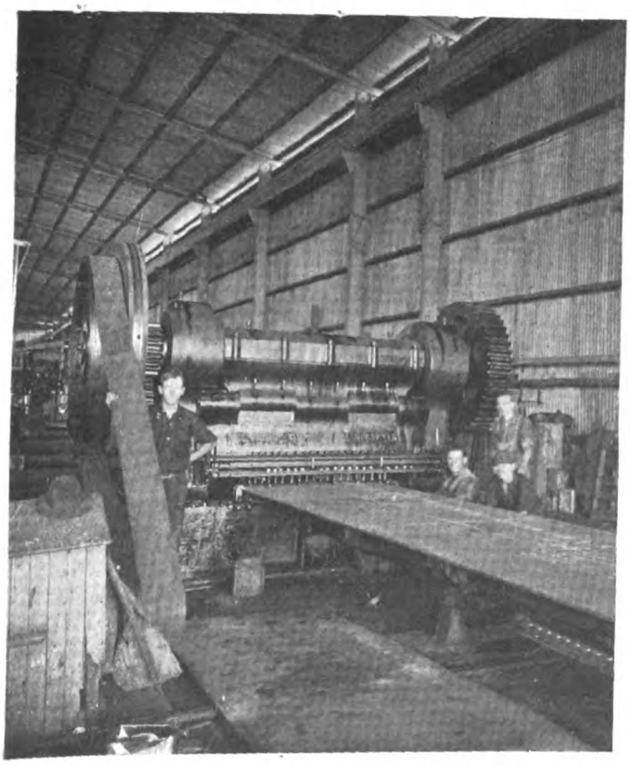

Fig. 1.—Multiple Punch with Automatic Spacing Table

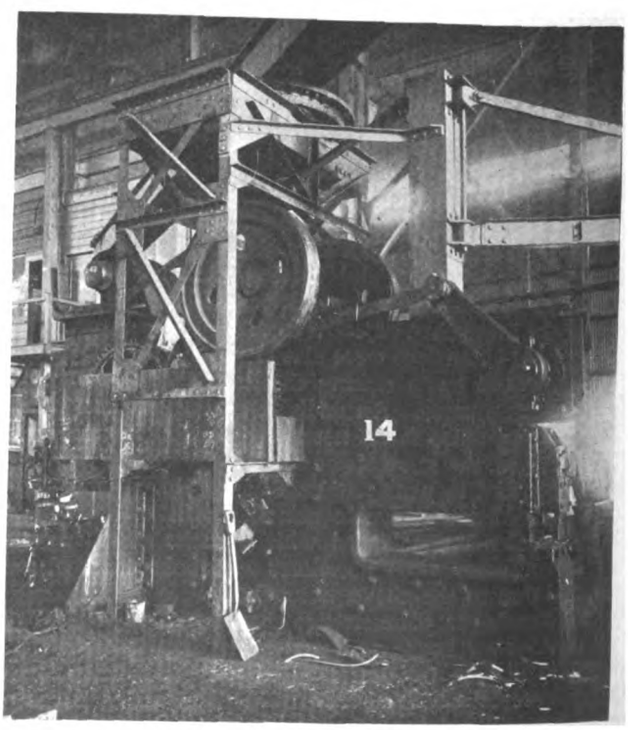

Fig. 2.—Punch and Shears with 4-Foot Gap

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Fig. 3.—Center Bay of Boiler Shop

and include 12 punching and shearing machines, large plate planers, countersinking machines, 12 high-speed radial drills, two large sets of rollers, a mangle and pneumatic and hydraulic presses. A large multiple punch, as shown in Fig. 1, is one of the most important units in this shop. This machine can handle plates up to 26 feet by 6.5 feet, and has an automatic spacing table.

The largest punch and shears is shown in Fig. 2. This machine, having a gap of 4 feet, can punch 1¼-inch holes in 0.75-inch plate. All machine equipment in this shop is driven by individual motors. The shop is served by three overhead electric traveling cranes.

Details of Boiler and Machine Shops

The boiler shop and machine shop are both housed in a steel structure 265 feet in length and 265 feet in width. Fig. 3 shows a portion of the center bay of the boiler shop, with stacks of headers and tubes of Babcock & Wilcox boilers ready to be assembled for installation in Commonwealth steamers. Fig. 4 shows the casings constructed for these boilers assembled outside the shop prior to placing them in the vessels.

The equipment of the boiler shop includes one large hydraulic riveter, having a depth of 13 feet and capable of handling the heaviest type of work; one large hydraulic squeezer, capable of taking plates up to 13 feet deep, and one large hydraulic press for flanging boilers, etc. An up-to-date vertical boiler shell, double-headed drill press, for position drilling of boiler work, is also an important part of the equipment of the shop. In one corner of the shop a large drawing floor for laying out work is provided.

The machine shop is completely equipped with modern machine tools. Fig. 5 shows a view of the bay containing the large lathes, etc. Special equipment includes an extension-bed, faced, chuck lathe, having a length of 20 feet between centers, a gap of 9 feet, with a face plate having a diameter of 14 feet.

Fig. 6 shows the central portion of the machine shop where erection work is performed. The two sets of engines shown are the propelling machinery for Commonwealth steamers. These engines are triple expansion,

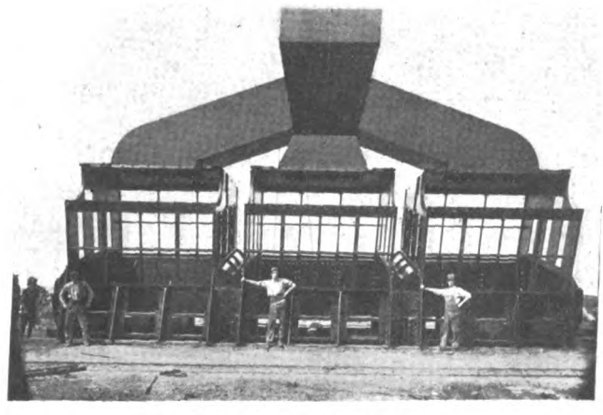

Fig. 4.—Boiler Casings Assembled

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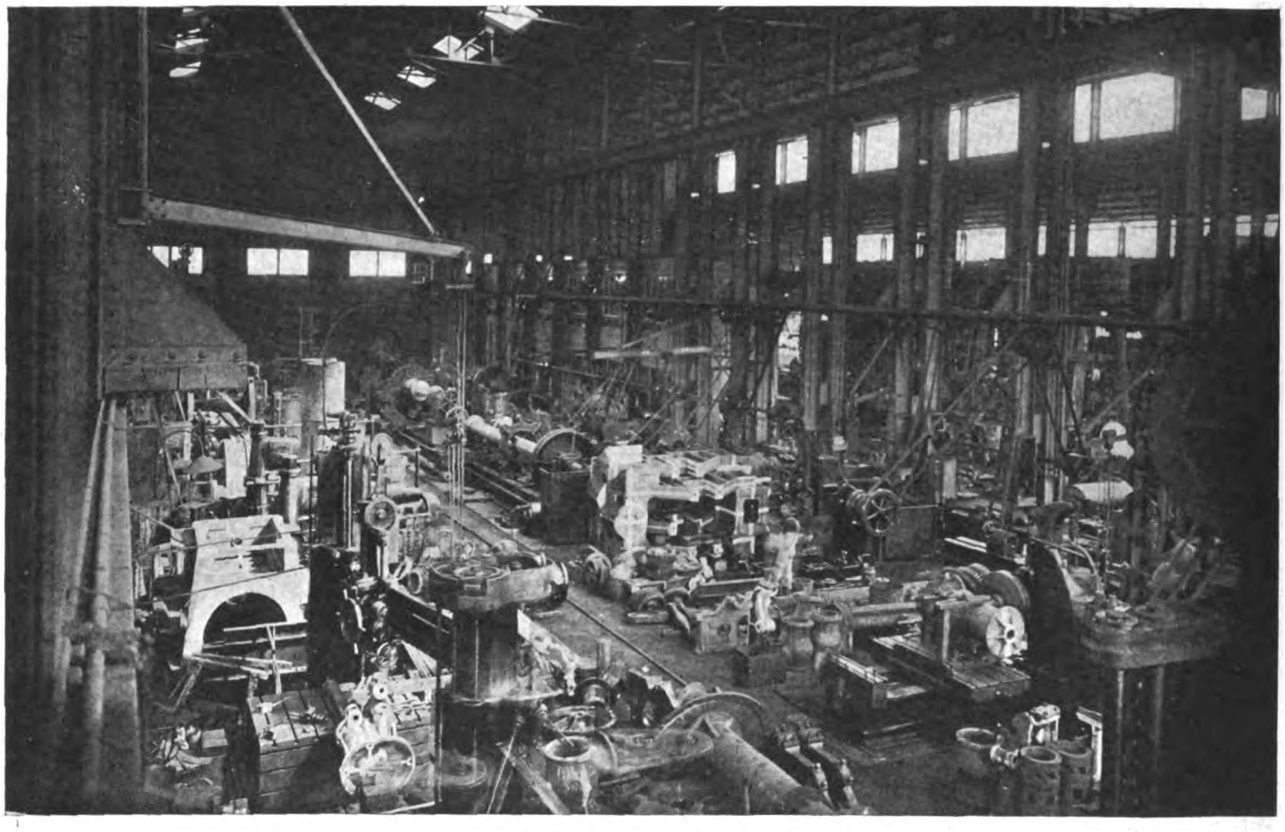

Fig. 5.—Center Bay of Machine Shop

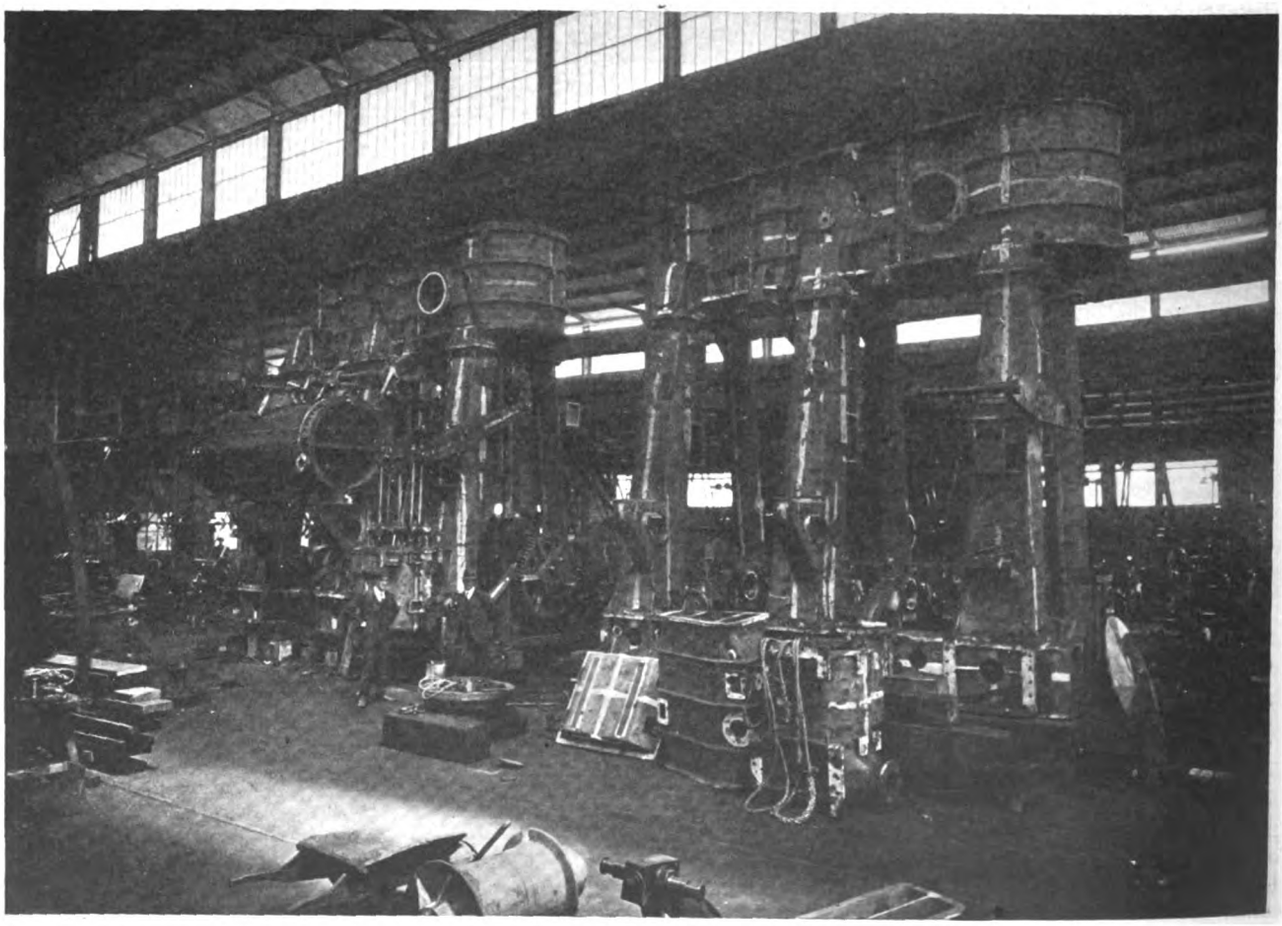

Fig. 6.—Assembling Floor of Machine Shop

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Fig. 7.—General View of Iron Foundry

developing 2,300 indicated horsepower, with cylinder diameters of 25 inches, 41 inches, 68 inches and 45 inches stroke.

The foundry is a large steel building 650 feet long by 150 feet wide. It is equipped with three furnaces and under and over electric traveling cranes.

A general view of the iron foundry is given in Fig. 7, while Fig. 8 shows the large pipe casting platform, an important part of the foundry work being the construction of cast iron pipes for the State water supply department as well as for private firms.

Fig. 9 shows that portion of the shop allotted to brass foundry work.

Forge Plant for Engine Work

The forging shop is well equipped and has a large steam hammer capable of a blow of 3 tons. All the heavy forging for crank shafts, etc., for the Commonwealth steamers was successfully carried out in the shop.

The blacksmith shop is a steel building 170 feet long and 90 feet wide, well lighted and ventilated, and is generally considered to be the best shop of its kind in Australia. It is equipped with powerful steam hammers, power presses, etc.

The mold loft is a wooden structure, having a floor length of 172 feet with a width of 70 feet. At the end of this building woodworking machinery is installed for handling the batten templates turned out for the plate shop.

The frame shop is situated under the same roof as the

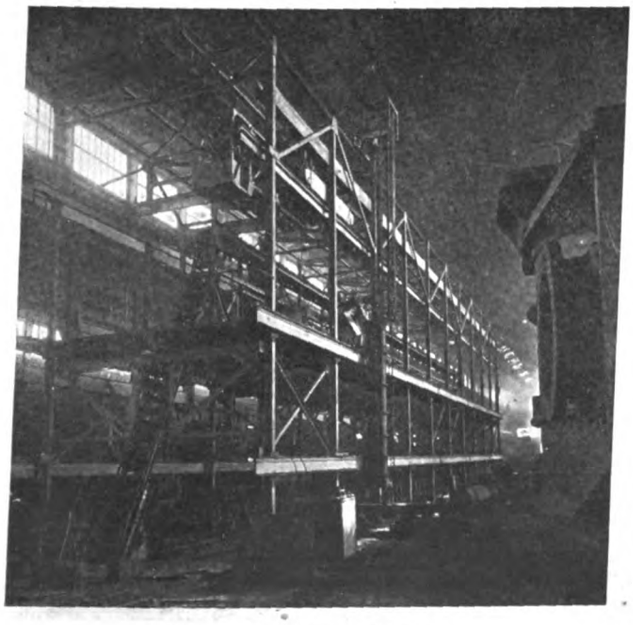

Fig. 8.—Pipe Casting Platform

Fig. 9.—Brass Foundry

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plate shop, and is equipped with a double-ended furnace capable of taking plates up to 33 feet by 8 feet, and a series of bending slabs at each end of the furnace with an area of 1,730 feet. A beveling machine is situated conveniently near to the furnace for beveling ship frames, etc. Portable hydraulic rams for bending frames are also provided.

Other shops in connection with the establishment consist of well-equipped plumber, coppersmith, galvanizing, pattern, joiner, paint, plate making and timber shops.

The works are operated by a board of control, of which the Minister of Works and Railways of Australia is the chairman. The other members of the board are the Director of Engineering and the Director of Shipbuilding, both members of Government boards, and the shipyard manager and engineering works manager of the yard itself.

Motorship Building in Europe

BY OUR SPECIAL LONDON CORRESPONDENT

AN event that is awaited with considerable interest in the British motorship building world is the completion of the first of the 14,000-ton, internal-combustion engined craft for the Glen Line, of which four are now under construction. These ships will surpass any similar boats that have yet been built, as not only are they larger, but they are designed for a speed of 14 knots, having a machinery installation of 6,400 indicated horsepower on twin screws. They are now being built at Glasgow by Harland and Wolff, who are also constructing the propelling and auxiliary machinery.

Although the engines are of the same nominal power as those installed in the *Glenapp* during the war, actually they develop considerably higher power, running at a lower speed and having larger cylinder dimensions. There are also many novelties in their construction, especially in the arrangement of the design of the framing for carrying the cylinders. Moreover, the whole of the auxiliary plant, which is on a large scale, is to be electrically operated, Diesel-driven generators being provided for installation in the engine room.

The marine oil engine having reached a stage when it permits the construction of 14,000-ton, 14-knot motor liners, the question immediately arises as to the employment of internal combustion motors on large and fast passenger boats. Speaking at the launch of the big Cunarder *Scythia* the other day, Sir James McKechnie, who is head of Vickers and is the designer of the well-known British submarine solid injection Diesel engines, stated that oil-fired boilers and geared turbines such as are installed in the *Scythia* are but the halfway house towards the oil-engine-driven passenger liner. Diesel engines of 4,000 horsepower are already being built, and it is anticipated that 6,000-horsepower, six-cylinder, two-cycle sets will be constructed within the course of the next year or two. By installing three of these engines in a passenger boat it would be possible to build a motorship of an equal size and power to many of the passenger liners now trading across the Atlantic.

The coal situation in England has become so acute that shipowners are in the greatest difficulties not only regarding their supplies but also because of the excessive running costs. The coal owners have lately agreed to reduce the price of bunker coals at British ports by $10 (40 o) per ton, but even now the nominal figure is $19 (75 -) per ton f.o.b. There are indications that the price will shortly be raised again to at least $25 (100 -), and it is therefore not surprising that the demand for motorships is increasing by leaps and bounds, and the only limit is the capacity for oil engine works to produce the necessary engines within a reasonable time.

Those motorships already on order are being pushed forward with the utmost rapidity, so much so that in some cases the trials of the engines in the works have been reduced to a minimum, a policy that may, perhaps, have unfortunate results. The new 10,800-ton motor tank ship for the Anglo-American Company is approaching completion at Vickers' yard and will be put into commission very shortly. She is the first post-bellum motorship constructed by the famous armament firm with engines of somewhat novel design, adopting the well-known Vickers solid injection system instead of using compressed air for the purpose.

All the large British marine engineering firms now recognize that it is inevitable for them to take up marine oil engine construction, and those who have not already done so are casting about for licenses for the construction of Continental types. The latest addition to the number is the firm of Hawthorne Leslie and Company, who are now building Werkspoor Diesel engines, while it is understood that Yarrows, who have long delayed coming to a decision, have at last decided on the manufacture of the Polar Diesel engine, somewhat on the lines of that built in America by McIntosh and Seymour, although it is believed that the Clyde firm will concentrate more upon the two-cycle than the four-cycle type.

There is in Europe, and especially in Great Britain, a big demand for the small seagoing cargo boat and the larger type of coaster carrying up to about 3,000 tons. In this field the semi-Diesel engine is seriously entering into competition with the Diesel motor, and in order to meet the requirements, two of the best-known British oil engine builders, namely, Beardmore and Vickers-Petters, have developed hot-bulb engines in four cylinders up to 600 brake horsepower per engine. It is thus possible to engine twin-screw ships with 1,200 brake horsepower, which is sufficient power for a 3,000-ton vessel, and the claim that is made, as against the Diesel engine, is that the semi-Diesel machinery is much simpler, costs less, and can be operated by less skilled engineers. In addition, Bolinders at Stockholm are manufacturing 500-horsepower engines as a standard model and are also developing one of 1,000 horsepower, this latter engine being now in the experimental stage, and if it proves successful it may have an important influence upon small motorship design in the future.

It is interesting to note that in connection with the development of this type of motor the first large motor trawler to be launched in England is fitted with one of the 600-brake-horsepower, Beardmore, semi-Diesel models. Trawler owners are watching this experiment with the greatest interest, for they have hitherto withheld their support from the internal combustion engine for use in trawlers, mainly on the score of unreliability and unsuitability for low speed. Beardmores hope to show the fallacy of these two opinions, and if they do there is little doubt that a big development in the construction of motor trawling may be anticipated.

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National Marine Week and Exposition an Overwhelming Success

WITH the sounding of "taps" at five bells (10:30 o'clock) on Saturday evening, April 17, the exercises of National Marine Week were ended, and the marine show at the Grand Central Palace, Lexington avenue and 46th street, the greatest exhibit of industries allied to the nation's maritime interests which has ever been held, came to a much-regretted end—regret that it could not have been continued for another week, or longer.

The celebration began at two bells (1 o'clock) on the preceding Monday, when Joshua W. Alexander, Secretary of Commerce, pulled the whistle cord of the Oriental Navigation Company's steamer *West Alsek* at Pier 86, North River, and started a chorus of answering whistles up and down the river. After that and some other scenes were captured for the films, the party, which included Secretary Alexander, Rear Admiral W. S. Benson, chairman of the Shipping Board; P. H. W. Ross, president of the National Marine League, 268 Pearl street, New York, under whose auspices the celebration was held; Murray Hulbert, Dock Commissioner of New York and Director of the Port; members of the House Committee on Merchant Marine and Fisheries, and many others, was escorted by a file of marines, boys from the Nautical Training School and the Morse Dry Dock and Repair Company's band to one of the large rooms on the pier, where luncheon was served.

After the luncheon, President Ross, in the absence of August Belmont, chairman of the executive committee of the League, who was kept away by illness, briefly explained the purposes of the League and the objects sought to be attained by the exposition. Captain Sampson, of the Oriental Navigation Company, welcomed the gathering as guests of the company and made them feel thoroughly at home, after which Commissioner Hulbert told what New York was doing and planned to do to keep the lead in the race for the commercial supremacy of the country, in the way of making the port what it should be, the greatest port in the world, the one whose facilities for prompt and cheap handling of cargoes and ships would be unequalled anywhere.

Rear Admiral Benson, in speaking of the policy of the Shipping Board, declared that constructive criticism from all who knew anything about and were interested in the problems confronting the American merchant marine and the Board would be welcomed. He said that he was willing to be "the goat," and in fact was willing to do or be anything which would advance the maritime interests of the United States; but as he had only been in office four weeks, he had hardly had time to get a firm grasp on all the details. As a general proposition, however, it could be taken for granted that the Shipping Board would do everything in its power to put the merchant marine on a firm business foundation.

He realized that the questions confronting the Shipping Board were of vital importance to the country, but felt sure that they would all be worked out satisfactorily, and that the National Marine League was doing a great and substantial work in the way of educating the people to the importance of keeping the American flag to the fore.

Secretary Alexander gave some interesting details of the results of the activity in American shipbuilding brought about by the demands of the great war, showing what an enormous task the country had accomplished, and the great responsibility which now rested on those who had the handling of the great fleet so quickly created. He took the statistics for 1919 and compared them with the figures for 1914, and emphasized the need for a thorough appreciation of the vital importance of the merchant marine to the welfare of the country, and the equal importance of having it owned, officered, manned, inspected, insured and absolutely controlled by Americans. He assured his hearers that so far as the Department of Commerce was concerned every effort it could put forth and all the influence it could bring to bear would be devoted to that end.

After the brief exercises at the pier the company was taken to the exposition, where, after a few words by President Ross, Secretary Alexander and Admiral Benson, the United States flag and the flag of the National Marine League were hoisted and saluted, the band played "Columbia, the Gem of the Ocean," and the exposition was formally declared open.

On Tuesday evening the ninth annual dinner of the League was held at the Hotel Commodore, about 800 guests being present. Admiral Benson was the chief speaker of the evening, followed by Henry R. Sutphen, vice-president of the Submarine Boat Corporation, and Captain Irving L. Evans, of the recruiting service of the Shipping Board. Major Belmont was still the victim of illness, but sent a cordial note expressing regret at his absence, hope for the success of the exposition, and faith in the future of the merchant marine.

Electric Drive and American Personnel

Admiral Benson in his remarks placed special stress on the need of American seamen for the merchant fleet and said he would like to see all alien sailors and officers on American vessels replaced by native mariners. He also advocated the development of the electric drive and the Diesel engine for motive power, and announced that this would be one of the things the Shipping Board would advocate and forward by every means in its power. Oil-burning ships, he said, were the ships of the future, the Board was establishing oil fuel stations all over the world, and American vessels would not be handicapped in that respect. He showed the necessity of the nation taking an "investing interest" in order to make the merchant marine a matter of national pride, and warned also against what he termed a continution of the anti-American propaganda so active during the war and now being used against the establishment of the merchant marine. With regard to the personnel of American vessels and the making of sailors and manning the fleets, he said, in part:

"A merchant marine to be successful must have the support of all Americans. The only way it will have the support is to make the opportunities for advancement in our merchant marine so great that American boys in large numbers will be attracted to again enter seafaring life as they did in the early history of our country. We must strive for the day when we can honestly say we have an all-American manned and owned merchant marine.

"We know how long it takes to build the average freight ship. We know how much that ship should earn to be profitable. What we are facing is the need of more of

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the right kind of youths trained for the sea, who enter our service on a merchant ship at the bottom rung with the hope, ambition and power to ultimately own the ship.

"Every hamlet has been reached in an effort to get the boys from interior towns to see life from a shipping point of view. Boys of vision should see the life as it is on board ships to know what fine training for future material happiness lies in store for them in the service of our merchant ships. It is easy work to obtain men to man the ships, but it is another matter to get men who are ship-minded and who enter the ranks with the hope and ambition to succeed as a ship operator."

Mr. Sutphen described the progress and development of American shipbuilding, the construction processes of the fabricated ships and the possibilities of the future for the merchant marine and the men who build the ships.

Captain Evans described the operation of the Shipping Board's recruiting service and training schools, the methods employed in making sailors and future officers out of raw country lads, congratulated the Marine League on its work and declared that the country need have no fear as to the quality of the men who would keep the flag afloat.

Deep Sea "Chanties" Sung by "Snugs"

Before the dinner a group of "old salts" from the Sailors' Snug Harbor, Staten Island, entertained the guests with a number of the old-time deep-water "chanties," including the "Dreadnought," "Blow the Man Down," "Whiskey, My Johnny," "Rio Grande," "Leave Her, Boys, Leave Her," and others, which were vigorously applauded, and one of the Snug Harbor men, 90 years old, was on the speakers' platform after the dinner and was cited by President Ross, of the Marine League, in his introductory remarks as being, like those Americans who had passed on the flag and now rested in Flanders Field, one of those who had borne the flag of the American merchant marine and now passed it on to the hands of the younger generation. Motion pictures of some interesting and intricate repair work at the Robins yard of the Todd Shipyards Corporation and the cruise of the training ship *Newport* were shown.

While this was going on at the Commodore, the three floors of the Grand Central Palace, which had been given over to the exposition, were crowded with people, many of whom had come out of curiosity, but went away with a lot of new ideas regarding the merchant marine.

The success of the exposition was overwhelming, and the throngs in attendance were so great that at times the doors had to be closed, the crowds going beyond what the police and fire departments deemed the safety limit.

Credit to Marine League

Pride and satisfaction in full measure justly belong to the National Marine League, 268 Pearl street, New York, for the time and labor expended in preparing for the celebration.

From far-off Tacoma to the whole length of the Atlantic seaboard, shipbuilders and all branches of industry connected with marine matters, as well as the Navy Department, the Department of Commerce and other Governmental agencies, have shown what they can do and are doing toward making the American Merchant Marine what it should be. The interest shown by the crowds which have attended the exposition is evidence that their efforts have achieved the result hoped for, and that the people are beginning to think ships.

Motion Picture Programme

The motion picture programme was of absorbing interest and kept the projection room full of spectators. The complete programme follows:

MONDAY, APRIL 12

Illustrated lecture on the "Diamond Mechanical Soot Blowers," by the Diamond Power Specialty Company.

Moving picture display by the Morse Dry Dock and Repair Company.

Illustrated lecture on the "Operation of the Barge Canal," by William T. Donnelly.

TUESDAY, APRIL 13

Moving picture film, "Keeping the Flag at Sea," by the Baltimore Dry Docks and Shipbuilding Company.

Moving picture display by the Astoria Boat Works.

Moving pictures showing the "Operation and Use of Delco-Light," by the Delco-Light Company.

Moving picture display by the Todd Shipyards Corporation.

Illustrated lecture by the Argonaut Salvage Corporation on the "Method of Recovering Sunken Cargoes and Raising Sunken Vessels."

Illustrated lecture by the Wilson Welder and Metals Company.

Moving pictures showing the "Operation and Use of Delco-Light," by the Delco-Light Company.

Moving pictures and lecture demonstrating the "Manufacture of the Allison Stockless Anchor," by Allison & Company.

Illustrated lecture by Mrs. Jaime C. de Veyra on "General Conditions in the Philippines" for the Philippine Commercial Agency.

WEDNESDAY, APRIL 14

Moving picture display of the "Poole Turbine and Gear Manufactured by the Ford Motor Company," by the Poole Engineering Company.

Moving picture and lecture demonstrating the "Manufacture of the Allison Stockless Anchor," by Allison & Company.

Moving picture and illustrated lecture by The De Vilbiss Manufacturing Company.

Moving picture display by the Columbian Rope Company.

Illustrated lecture by the Lake Engineering Company describing the advantages of the commercial submarine boat and apparatus for submarine exploration and investigation, and in recovering the natural products of the seas; also on their ability to materially shorten certain trade routes.

Moving picture film, "Keeping the Flag at Sea," by the Baltimore Dry Docks and Shipbuilding Company.

Moving picture display by the United States Shipping Board.

Moving picture display by the Todd Shipyards Corporation.

Moving picture display by the Camden Forge Company.

Moving picture display demonstrating the "Kitchen Patent Maneuvering and Reversible Rudders," by the Kitchen Reversing Rudder Company.

Moving picture display by the Submarine Boat Corporation.

THURSDAY, APRIL 15

Illustrated lecture on "General Conditions in the Philippines," by Mrs. Jaime C. de Veyra, for the Philippine Commercial Agency.

Moving picture of activities at Camp Sims—National Nautical School for the Boys of America.

Moving pictures and illustrated lecture descriptive of "Triple Safety Glass," by the Triple Safety Glass Corporation.

Moving picture display by the Camden Forge Company.

Moving picture display demonstrating the "Kitchen Patent Maneuvering and Reversible Rudders," by the Kitchen Reversing Rudder Company.

Moving picture display by the Todd Shipyards Corporation.

Moving picture display by the International Mercantile Marine Company.

Moving pictures and illustrated lecture on the "Gyroscope as an Aid to Marine Transportation," by the Sperry Gyroscope Company.

Moving picture display by the Columbian Rope Company.

FRIDAY, APRIL 16

Moving picture film, "Keeping the Flag at Sea," by the Baltimore Dry Docks and Shipbuilding Company.

Moving picture display by the United States Shipping Board.

Lecture by the American Red Cross (Insular and Foreign Division).

Moving pictures of cruise of the New York State Nautical Schoolship *Newport*.

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Moving picture display by the Morse Dry Dock and Repair Company.

Moving picture and illustrated lecture by the De Vilbiss Manufacturing Company.

Moving picture display by the Astoria Boat Works.

Moving picture and illustrated lecture descriptive of "Triplex Safety Glass," by the Triplex Safety Glass Corporation.

Moving picture display of the "Poole Turbine and Gear Manufactured by the Ford Motor Company," Pool Engineering Company.

SATURDAY, APRIL 17

Moving picture display by the Department of Commerce.

Moving picture display by the International Mercantile Marine.

Moving pictures of cruise of the New York State Nautical Schoolship *Newport*.

Moving pictures of activities at Camp Sims.—National Nautical School for the Boys of America.

Lecture by Uttmark's Nautical Academy.

Illustrated lecture on the "Method of Recovering Sunken Cargoes and Raising Sunken Vessels," by the Argonaut Salvage Corporation.

Illustrated lecture describing the advantages of the commercial submarine boat and apparatus for commercial exploration and investigation, and in recovering the natural products of the sea. Also on their ability to materially shorten certain trade routes. By the Lake Engineering Company.

WHAT WAS DONE ON SPECIAL NIGHTS

The programme for special nights and addresses in the lecture hall included:

MONDAY, APRIL 12—*Shipbuilding Night*

Address by Holden A. Evans, president of the Baltimore Dry Docks and Shipbuilding Company; subject, "Shipbuilding and the Merchant Marine."

Moving picture film, "Keeping the Flag at Sea."

Meeting of The Marine Press of America.

TUESDAY, APRIL 13

Welcome to Navy Men, by P. H. W. Ross, president of the National Marine League.

WEDNESDAY, APRIL 14—*Engineering Night*

"The Use of Boilers for Generating Steam," by Mr. Walter McFarland, of the Babcock and Wilcox Company.

"Queen of the Waves," a special film showing development of electric drive through all the stages of marine transportation. Mr. B. S. Beach, General Electric Company.

"Turbines and Turbine Reduction Gears," by Mr. P. M. Robinson, Westinghouse Electric & Manufacturing Company.

"Inland Navigation," by Mr. William T. Donnelly.

"Diesel Engines for Ship Propulsion," by Dr. C. E. Lucke.

THURSDAY, APRIL 15—*Travel Day*

Luncheon at Hotel Commodore, under auspices of Travel Club. Addresses on "Travels in the Land of Kublai Kahn," by Roy Chapman Andrews, and "With Peary at the Pole," by Captain Robert A. Bartlett.

"A Tour of the West Indies and the Panama Canal," by Mr. Henry Collins Walsh, president of the Travel Club of America. Illustrated with colored slides and with motion pictures of the Panama Canal loaned for this occasion by General George W. Goethals, builder of the canal.

Motion pictures of the building of American ships during wartime at the Virginia shipbuilding plant of the United States Steamship Company. These include pictures of President Wilson driving the first rivet in the keel of the first vessel built at the plant and the launching of the first vessel.

"Sumatra, Its People, Their Manners, Customs and Industries," by the Universal Film Company, New York. Motion pictures taken by a special expedition sent out by the company. This was its first showing.

"Mountaineering in Our National Parks," by Mr. LeRoy Jeffers, F.R.G.S., general secretary of the Associated Mountaineering Clubs of North America. Illustrated with colored slides of rare beauty, showing some little-visited sections of our wonderful parks.

FRIDAY, APRIL 16—*Fuel Night*

"Colloidal Fuel," by Lindon W. Bates, assisted by Dr. S. E. Shepherd, chief chemist, Kodak Research Laboratory, Rochester, N. Y.

"The Bunkering Problem of the American Merchant Marine," by Captain Paul Foley, United States Shipping Board.

"Coal and the Merchant Marine," by Mr. LeBaron S. Willard.

"The Story of Oil," a film loaned by the United States Bureau of Mines.

SATURDAY, APRIL 17—*Merchant Mariners' Day*

Welcome to Merchant Mariners, by P. H. W. Ross, president of the National Marine League.

Chantey singing by delegation from Sailors' Snug Harbor, Staten Island.

General reception to merchant mariners. Captain Arthur N. McGray, chairman of the committee.

Address by Governor Alfred E. Smith; subject, "The Need for a Merchant Marine."

Moving picture film, "Keeping the Flag at Sea."

Exhibits at the Marine Exposition

The list of exhibitors with their displays follows:

A

Admiral Anchor Company, 111 Broadway, New York.—Samples of the Admiral Stockless Anchor, of various sizes.

Alberger Pump & Condenser Company, 140 Cedar street, New York.—Alberger occluders, Wainwright feed water heaters, oil coolers, and expansion joints; Alberger Spirotlo condensers, centrifugal boiler feed pumps.

Allison Anchor Company, Chester, Pa.—Model of stockless anchor; anchor destroyed by acetylene torch and pulled to test of 12,000 pounds, or 8,000 pounds above Shipping Board test.

Aluminum Cooking Utensil Company, 1328 Broadway, New York.—Outfit of kitchen, and galley jacketed kettles and range utensils.

Amalgamated Bituminous Corporation, Pier 11, New York.—Bituminous compounds, for the interior of ships; rust and corrosion prevention.

Amalgamated Paint Company, Pier 11, North River, New York.—Ship paints, and anti-fouling composition; models of ships camouflaged.

American Car & Foundry Company, 165 Broadway, New York.—Three and five phase Berwick electric rivet heaters in operation.

American Clay Machinery Company, Bucyrus, Ohio.—Single drum, single geared, double cylinder reverse valve steam winch.

American Engineering Company, Philadelphia, Pa.—Electro-hydraulic steering apparatus, windlasses, cargo hoists, towing machines.

American Library Association, 31 West 15th street, New York.—Pictures, flags, books.

American Manganese Bronze Company, Holmesburg, Philadelphia, Pa.—Propellers of manganese bronze.

American Manufacturing Company, Noble and West streets, Brooklyn, N. Y.—Manila and sisal rope, marine cordage.

American Mast & Spar Corporation, 110 W. 40th street, New York.—Sticks, spuds, booms, post and columns and waterproof cloth.

American Seamen's Friend Association, 76 Wall street, New York.—Projection machine, and library on the steamer Roosevelt used by Peary on his trip to the North Pole.

American Ship Supply Company, 110 W. 40th street, New York.—Marine canvas work, masts and spars, ship chandlery.

American Standard Ship Fittings Corporation, 115 Broadway, New York.—Marine hardware, galley equipment, ventilators, and ship fittings.

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American Steel Foundries, 30 Church street, New York.—Dunn stockless anchors.

Arnesto Paint Company, West 99th street, New York.—Anti-fouling compositions, ships paints.

Asbestolith Manufacturing Company, 1 Madison avenue, New York.—Fireproof, sanitary, germ-proof, non-corrosive floor coverings; cross section of floor and cover base without joints.

Astoria Boat Works and Equipment Company, 559 Boulevard, Long Island City, N. Y.—Life boats, small vessels, marine equipment, with models of life-saving boats.

Atlantic-Pacific Manufacturing Company, 124 Atlantic avenue, Brooklyn.—Life saving equipment, cork life belts and jacket-collar life preservers, buoys, Kapok jacket collar life preservers, water lights, fenders, etc.

Atlas Soot Blower Company, 101 Park avenue, New York.—Atlas soot blower for horizontal fire tube boilers.

Automobile Insurance Company, Hartford, Conn.—Beautifully decorated booth with a model of Columbus caraval Santa Maria, gilded.

B

Baker, H. W., Linen Company, 41 Worth street, New York.—Lighthouse, and display of linen and bedding.

Baltimore Dry Docks & Shipping Company, Baltimore, Md.—Large paintings of the yards, plant, buildings and ways.

Beaver Tile & Specialty Company, 44 Cliff street, New York.—Beaver colored cork tile, for decks.

Bendus, J. V., 39 Cortlandt street, New York.—Waterproof tent.

Benjamin Electric Company, 243 W. 17th street, New York.—Marine lighting and signalling apparatus, deck and bulkhead watertight fixtures.

Benson Electric Company, 2 Rector street, New York.—Non-glare flood lamp, electric steeromotor for motorships, flash lights, electric whistle and other appliances.

Bernstein Manufacturing Company, 3rd and Allegheny avenue, Philadelphia, Pa.—Berths, ship beds, bedding and metal furniture.

Boston Engineering Company, Boston, Mass.—Valves and model of Sturrock bridge walls.

Boucher, H. E., Manufacturing Company, 150 Lafayette street, New York.—Models of pleasure boats, engines, merchant vessels, and a torpedo boat destroyer.

Bowler, Holmes & Hecker Company, Inc., 259 Greenwich street, New York.—Electrically-driven pump, built for United States Government for use on battleships.

Bowman, M. K., Edison Company, 65 Dey street, New York.—Electric trucks, bullet tube brush, and photographs of interior of company's factories.

Boy Scouts of America, 200 Fifth avenue, New York.—Scouts in uniform showing operations at camps, wigwag systems, method of instruction, etc.

Bramhall, Deane & Company, 261 West 36th street, New York.—Ranges, kettles, cabinet ovens, urns, etc., for marine use.

Brandis & Sons, Inc., and E. S. Ritchie & Company.—Ritchie Compasses and Brandis Sextants.

Judson Brown Company, 30 Church street, New York.—Pumps, windlasses, chains and anchors, etc.

Brunswick Refrigerating Company, New Brunswick, N. J.—Refrigerating machinery and refrigerators, with compressor pump in operation.

Buzzini, Inc., Walter J.—505 West 21st street, New York.—Galley and pantry equipment.

C

Callaphone Company, Grand and Lafayette streets, New York.—Electric communicating systems, amplifying calls and picking up answers for stores, factories, etc.

Camden Forge Company, Camden, N. J.—Heavy forgings, thrust shafts, etc., for ship and engine builders.

Camp Sims.—Scene of part of the camp and nautical cadets.

Campbell, G. W., 253 Broadway, New York.—Cole course protractor, Erickson gas flue retarder, paddles, oars, handles.

Cashell Company, Marbridge Building, New York.—Koppax paint for preserving outdoor structural steel work.

Chadburn Ship Telegraph Company of America, Troy, N. Y.—Ship telegraphs and signalling apparatus, indicators and counters; Bassnett's sounding machine, and clear view screens for pilot houses.

Clothel Company, 61 Broadway, New York.—Refrigerating machine, and units for the use of ethyl chloride as a refrigerator.

Coen Company, 50 Church street, New York.—Machinery for the mechanical burning of oil in steam generation, valves, etc.

Columbian Rope Company, Auburn, N. Y.—Large coil of 10-inch rope weighing 3,200 pounds, other kinds and sizes of rope all having the private trade mark of red, white or blue line through the centre of the rope; display of unspun hemp; board showing various knots.

Cornell Emery Company, 25 Broadway, New York.—Ship furnishings and decorations, mattresses, curtains, upholstery, etc.

Cory, Charles & Son, Inc., 290 Hudson street, New York.—Electrical equipment, telephones, telegraphs, compasses, lighting fixtures, etc.; model of the first mechanical ship's telegraph ever built, invented December, 1862.

Cory, Herbert H., Inc., Norfolk, Va.—The Navy Stockless Anchor.

Crandall Engineering Company, East Boston, Mass.—Photographs of yards and dry docks, model steamer.

Cutler-Hammer Company, 50 Church street, New York.—Automatic truck and screen speed light controllers, reversing panels for submarine diving gear, motor starters, electric heaters, and other equipment; electrical melting pots.

Cutting & Washington Radio Corporation, 6 West 48th street, New York.—Radio apparatus.

D

DeLaval Separator Company, 165 Broadway, New York.—Centrifugal oil purifiers; motor-driven marine type in operation.

DeLaval Steam Turbine Company, 165 Broadway, New York.—Turbines, double helical speed reduction gears, turbine driven pumps, etc.

Department of Commerce, Bureau of Navigation, Lighthouse Department and Coast and Geodetic Survey.—Range finding radio exhibit, fourth class flashing light 37,000 candle power, radio distance and direction signalling, fog horns, all in operation; maps, charts of harbors, plates, copper and aluminum from which they were printed; life boats and life saving apparatus, channel flashlights operated by clock work and electricity and models of various vessels.

DeVilbiss Manufacturing Company, 1288 Dorr street, Toledo, Ohio.—Equipment for painting ships by the pneumatic spraying process.

Devoe & Raynolds Company, Inc., 101 Fulton street, New York.—Sample color sheets of marine paints and varnishes.

Dew Valve Company, 149 Broadway, New York.—Automatic relief valves for draining steam cylinders.

Diamond Power Specialty Company, Detroit, Mich.—Full size models of various types of soot blowers; model of Scotch marine boiler, sample of soot, test data, blue prints, photographs.

Dodge Sales & Engineering Company, 21 Murray street, New York.—Model of heavy oil internal combustion marine type engine; generator sets.

Domestic Electric Company, 52 Park Place, New York.—Delco-Lights for commercial and pleasure craft, showing method of installation and operation.

Donnelly, Wm. T., 17 Battery Place, New York.—Photographs, maps and plans.

Downey Shipyards, Arlington, S. D., N. Y.—Painting of New York harbor, models of engines, plans of shops, and models of ships.

DuParquet, Huot & Moneuse Company, 108 W. 22nd street, New York.—Electric oven, and other electric galley equipment.

Durkee Manufacturing Company, Inc., Grasmere, Staten Island, N. Y.—Nautical and airplane instruments, electrical apparatus and specialties.

E

Electric Arc Cutting & Welding Company, 222 Halsey street, Newark, N. J.—Portable alternating current, welding devices, masks, shields, glasses, and other equipment

Electric Service Supplies Company, 17th and Cambria streets, Philadelphia, Pa.—Keystone turbo-generators, Golden Glow searchlights, footlights; Keystone contact rail material and guards.

Electric Tachometer Corporation, 35 North Broad street, Philadelphia, Pa.—Pedestal type bridge case, engine room counters, tachometers, marine equipment.

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Electros Manufacturing Company, 60 Washington street, Brooklyn, N. Y.—Specimens of Electros insulation for electrical and mechanical purposes.

F

Falls Hollow Staybolt Company, 81 Fulton street, New York.—Specimens of hollow and solid staybolts for railroad and marine boilers.

Foamite Firefoam Company, 200 Fifth avenue, New York.—Illustrations of fire fighting process with specimens of apparatus, hand extinguishers, portable engines, and pails.

Fuller, George A., Company, Carolina Shipyard, Wilmington, N. C.—Models of ships, pictures, etc.

G

General Electric Company, Schenectady, N. Y.—Operation of the G-E arc welding set, steam driven generating sets, crank shafts, couplings, connecting rods, governors, piston valves, cylinder and stuffing boxes, cross section of engine showing forced lubrication type, and generator with direct connected exciter connected with steam engine; a two-plane geared turbine showing operation; other electrical equipment for maritime use.

Globe Shipbuilding & Dry Dock Company of Maryland, Baltimore, Md.—Models of ships and hulls Nos. 101, 102; model of yard with ships on ways, and dry docks.

Globe Car Heating Company, 17 Battery Place, New York.—Thermostatic heat regulating system in operation.

Gregory Galvanizing Works, Pittsburgh, Pa.—Galvanized cowls, stanchions, anchors, boilers, pipe fittings, chain, etc.

Guarantee Exterminating Company, 400 5th avenue, New York.—Masks used in fumigating ships, literature, etc.

H

Hamilton & Hansell, Inc., 13 Park Row, New York.—Automatic and hydro-hydraulic sal-log.

Hansen & Yorke Company, 88 Warren street, New York.—Dies and die stocks, chain hoists, bolts.

Hartman Company, Charles, 981 Dean street, Brooklyn, N. Y.—Deck and interior ventilators.

Hooven-Owens-Rentschler Company, Hamilton, Ohio.—Pictures, turbines, model of their plant.

Howden, James, & Company of America, Inc., Wellsville, N. Y.—Models of forced draft apparatus as applied to the four largest steamers in the world.

Hubbard, Charles, & Company, 81 Fulton street, New York.—Forgings, castings, staybolts, etc.

Hudson River Day Line, Desbrosses Street Pier, New York.—Models of Hudson River steamers.

Hyde Windlass Company, Bath, Maine.—Tower of graded sizes of manganese bronze propellers, windlass, winch, and hoisting equipment.

I

Industrial & Sales Corporation, 2 Rector street, New York.—G-O line throwing gun, and equipment, with method of operating shown.

International Flag Company, Jamestown, N. Y.—Brilliant display of flags.

International Mercantile Marine Company, 9 Broadway, New York.—Large models of the steamers *Kroonland* and *St. Paul.*

International Nickel Company, 43 Exchange Place, New York.—Samples of monel metal and nickel steel.

Irving Iron Works, Long Island City, N. Y.—Section of subway grating for wharves, stairs, floors, and engine room decks.

J

Jahncke Dry Dock & Ship Repair Company, Inc., New Orleans, La.—Photographs and pictures.

Jersey City, N. J.—Large model of proposed waterfront development.

Johannsen, H. S., 50 Church street, New York.—Winch driven by Skandia oil engine of 13 horsepower, 5,000 pounds on single line; engines from 9 to 500 horsepower and Werkspoor Diesel engines to 2,000 horsepower.

Johnson Shipyards Corporation, Mariners Harbor, S. I., N. Y.—Pictures of yard, small model.

K

K-G Welding & Cutting Company, 556 West 34th street, New York.—Welding and cutting units, blau-gas and oxy-acetylene cutters.

Kahnweiler's Sons, David, 260 Front street, New York.—Steel line throwing gun.

Kennedy, David E., Inc., 55 Fifth avenue, New York.—Everlastic floor tile, samples of artistic design and color.

Kidde, Walter, & Company, 149 Cedar street, New York.—Models showing the Rich system of fire detection and extinguishing on board ship.

Kingsbury, Albert, Oliver Building, Pittsburgh, Pa.—A 14-inch marine Kingsbury thrust bearing, and ordinary multi-collar horseshoe type bearing on a single shaft, mounted for friction tests and comparisons; 23-inch bearing arranged for detailed examination.

Kitchen Reversing Rudder Company, Ltd., Liverpool, England.—Reversing rudder in operation on electrically propelled model in large tank.

L

Lake Engineering Company, New London, Conn.—Model of ship and tanks, with birds and mice living in glass diving bells.

Lehigh University, Bethlehem, Pa.—Pamphlets and data on ship construction and marine transportation, with curriculum of engineering school and pictures.

Leslie Company.—Leslie pressure regulators and valves.

Lovell & Company, Arlington, N. J.—Lighting fixtures.

Lidgerwood Manufacturing Company, 96 Liberty street, New York.—Automatic tension towing engines, 16-inch drum steam winch, electric cargo winches.

Linotol Flooring Company, Inc., 15 Whitehall street, New York.—Plastic flooring material.

Locomotive Superheater Company, 30 Church street, New York.—Four-furnace model Scotch marine boiler in vertical section showing location of fire tube, superheater units and headers; horizontal section marine boiler; pyrometer; forged returned bend in several sizes and sections.

Luckenbach Steamship Company, 44 Whitehall street, New York.—Model of steamship *Louis Luckenbach* with side cut out showing cargo and storage space.

Lunkenheimer Company, 120 Lafayette street, New York.—Oil cups, valves, whistles and engineering specialties.

Lybeck Ocean Harvester Company, Inc., 134 W. 36th street, New York.—Model of an ocean harvester; fish catching by wholesale.

M

McNab Company, Bridgeport, Conn.—Octopus lubricator, engine room counters, log meters, ship's hardware and other equipment.

Mack Engineering & Supply Company, 123 Liberty street, New York.—Mackcaps staybolt nut protectors, Mack H. T. cement for high temperature brick work.

Mallory Industries, Inc.—Wireless equipment, ventilating turning gears, heaters, washing machines and electrical apparatus.

Marine Works, The, 31 Coenties Slip, New York.—Galley and cabin outfits, heavy marine hardware, sheet metal work and oil burners.

Maritime Hydraulic Oil Service, 101 Broadway, Detroit, Mich.—Model of application of Farr hydraulic oil system.

Merchant Shipbuilding Corporation, 120 Broadway, New York.—Photographs of Harriman and Chester, Pa., yards, and vessels on ways.

Mott, J. L., Iron Works, Trenton, N. J.—Marine plumbing fixtures.

Mississippi Wire Glass Company, 220 Fifth avenue, New York.—Port and deck lights, specimens of wire glass for port holes.

Morse Dry Dock & Repair Company, Brooklyn, N. Y.—Model of yards, showing dry docks with vessels floating, and out of order; large model of steamer *Mauretania*, and smaller models of various types; daily paper of exhibition.

Munson Steamship Line, 82 Beaver street, New York.—Models of steel steamships *Luristan*, *Tarbarista* and *Munamar.*

N

Navigator Log Corporation, Park Row Building, New York City.—Automatic navigator log.

National Hoisting Engine Company, Harrison, N. J.—Heavy duty ship winch, built on duplicate part system, with complete spares in stock.

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Neptunus Ship Supply Company, 73 Front street, New York.—Erfman boiler water controller to determine amount of soda ash needed to keep boilers free of oil, grease, deposit and corrosion.

Newburgh Shipyards, Inc., Newburgh, N. Y.—Model of steamer *Olancho,* built for Cuyamel Fruit Company; large painting of the company's first vessel for the Shipping Board, the *Newburgh;* model of old Chinese water carrying junk.

City of New London, Conn.—Views of the city, and folders showing views, including Ocean Beach.

New London Ship & Engine Company, Groton, Conn.—Models of heavy duty marine type Diesel engines, with reverse gears.

New Process Chemical Company, 39 Cortland street, New York.—Marine glues, paints, hull seam composition.

New York Eingineering Company, 2 Rector street, New York.—Marine watertube boilers.

New York Marine Engineers' Beneficial Association, 26 Park Place, New York.—Flags and literature, model of cruiser *Iowa;* pictures of cross section of *S. S. Agamemnon* with reciprocating engines, and *S. S. Turbui.*

Nicholas Power Company, 88 Gold street, New York.—Cameragraphs and motion picture projection machine details.

O

Ocean Paint Works, 16 Whitehall street, New York.—Mermaid marine paints; fillers, paints and oils for use on shore.

Ohio Body & Blower Company, Cleveland, Ohio.—Swartwout Admiralty ship cowls, turning gears and other fittings.

Oriental Navigation Company, 39 Broadway, New York.—Model of one of the Donald Line steamers taken over by this company.

Oxweld Acetylene Company, 30 East 42nd street, New York.—Apparatus for cutting and welding of metal by the oxy-acetylene process, with specimens of work. The company distributed a booklet on permitted welding applications which should be used for reference in all shipbuilding yards.

P

Page Steel & Wire Company, 30 Church street, New York.—Armco iron rods and wire for oxy-acetylene and electric welding, and ingot iron wire for mechanical welding.

Paige & Jones Chemical Company, 15 East 40th street, New York.—Clarion paint oil for mixing with dry red lead without linseed oil.

Pantasote Company, 11 Broadway, New York.—Ship's cabin built of vehisote, furnished and illuminated.

Peterson, K. G., 29 Flatbush avenue, Brooklyn.—Marine photographer; exhibit of deep sea photographs, etc.

Philippine Commercial Agency, Grand Central Palace, New York.—Agricultural, forestry, mineral and oil products of the Philippine Islands.

Pioneer Metallic Packing Company, Inc., 150 25th street, Brooklyn, N. Y.—Metallic packing for cylinders, with split cases for installation or repairs without disconnecting rods.

Pneumercator Company, 15 Park Row, New York.—Draft gages, tanks, upright and horizontal, indicators for marine and land use.

Poole Engineering Company, Baltimore, Md.—Circulating pump, turbine-driven gear, centrifugal pumps used for collecting water for condenser, 30 horsepower turbine reduction gear, 62 horsepower; refrigerating machine ½-ton capacity, using ethyl chloride.

Port of New York Society, 166 Eleventh avenue, New York.—Model of old-style full rigged ship.

Power Specialty Company, 111 Broadway, New York.—Foster superheater for installation in boiler uptakes.

R

Ramsay Company, 140 Cedar street, New York.—Model in action of patent anticipating marine engine governor.

Reading Valve & Fittings Company, Reading, Pa.—Steel fittings, valves, flanges, etc.

Reid & Company, John, 30 Church street, New York.—Models of forced draft equipment for marine work.

Richmond Engineering Company, Richmond, Va.—Plate, bar and sheet metal products, universal terminals for ship ventilation.

Row & Davis, 91 West street, New York.—Paracoil evaporators, feed water heaters, fresh water still, feed water filter and grease extractor.

S

Schutte & Koerting Company, Philadelphia, Pa.—Humidifiers, pumping outfits, steam or belt driven; ventilating apparatus, feed water heater, bilge syphons.

Shipping Board, Division of Operations—Relief map of the world, 38 by 15 feet, showing trade routes and vessel lines. The Emergency Fleet Corporation—Model 1/10 size of 13,000 deadweight ton cargo and passenger ships (the vessel of which this is a model was described in detail in the April issue of MARINE ENGINEERING), models of vessels from the *Clermont* to the modern liner, showing the progress of steamship construction. Supply and Sales Division, samples of surplus and salvage material, equipment tools, etc., on sale. Catalogues on application.

Shonberg, I., 122 Flushing avenue, Brooklyn, N. Y.—Samples of babbit metal, line shaftings, etc.

Simpson Gordon Patents, Inc., 17 Battery Place, New York.— Model of steamers being built at the Newburgh Shipyard, showing bilge tunnels carrying main shafting, and the Simpson topside water ballast tanks.

Sinclair Oil Refining Company, 120 Broadway, New York.—Samples of oil.

Skinner & Eddy Corporation, Seattle, Wash.—Models of standardized ships built by the company.

Standard Oil Company, 26 Broadway, New York.—Picture of Grand Canyon of the Colorado.

Staten Island Shipbuilding Company, Staten Island, N. Y.—Model of shipbuilding yard and models of vessels built by the company.

Steward Davit & Equipment Company, 17 Battery Place, New York.—"Mutt" and "Jeff" Davits, life boat and full equipment of apparatus for saving life at sea.

Sturrock Furnace Bridge Wall Company.—Furnace bridge walls for boilers, pump valves, etc.

Sturtevant Company, B. F., Hyde Park, Boston, Mass.—Generating sets, blowers, etc.

Submarine Boat Corporation, 5 Nassau street, New York.—Large detailed model of Newark Bay Shipyard; model of 5,350 deadweight tons standardized ships, 7 feet long, and other vessels.

T

Tacony Steel Company, 2 Rector street, New York.—Heavy marine forging, piston rods, bars, billets, etc.

Texas Company, 17 Battery Place, New York.—Petroleum products.

Thorne-Pioneer Company, Inc., 3 Atlantic avenue, Brooklyn, N. Y.—Metallic packings for marine and stationary engines, steam pumps and compressors.

Thorsen, P. S., & Company, Inc., 81 Coffey street, Brooklyn, N. Y.—Vitribestos sheet and cement for steam pipe and boiler covering; asbestos insulations.

Tiebout, W. & J., 118 Chambers street, New York.—Caldwell sash balances, and marine hardware.

Todd Shipyards Corporation, 15 Whitehall street, New York.—Model of Tacoma, Wash., repair plant, large model of modern ocean liner in six-section floating dry dock in the Robins yard in operation, vessel being floated and lifted out of water; models of marine engines, steam yachts, and vessels built at the various plants of the corporation; oil burning engines and equipment.

Topping Brothers, 122 Chambers street, New York.—Heavy marine hardware, shipbuilders', contractors' and railway supplies.

Triplex Safety Glass Corporation, 1778 Broadway, New York.—Safety glass for port holes, sighting panels, and other purposes.

Turbine Air Tool Company, Cleveland, Ohio.—Air tools run by turbines in action.

U

Union Sulphur Company, 17 Battery Place, New York.—Samples of sulphur.

United Marine Contracting Corporation, 15 Whitehall street, New York.—Automobile truck carrying electric welding apparatus.

United States Navy Department.—Models of old and new war vessels, from battleships to torpedo boat destroyers, battery of three torpedo tubes, torpedo, radio service, models of powder charges and projectiles, naval guns, cross section of battleship, paravane, relief plan of New York harbor and ap-

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proaches showing lighthouses, channels and moving vessels, mines, anti-air craft and rapid fire gun; samples of tools, hardware and equipment, and other surplus material to be sold.

United States Steamship Company, United States Transport Company, 50 Broad street, New York.—Models of ships, pictures, maps of shipyard at Alexandria, Va.

Upson Walton Company, 291 Broadway, New York.—Anchors, nautical instruments.

V

Valentine & Company, 456 Fourth avenue, New York.—Marine paints, enamels, brass polish preservative for exterior and interior of ships.

Van Nostrand Company, 25 Park Place, New York.—Military and Naval Books, Nautical Manuals.

Virginia Iron Works, Norfolk, Va.—Ship repair facilities.

Vulcan Iron Works, Inc., Jersey City, N. J.—Models of marine engines and boilers, the Parsons marine steam turbine.

W

Wager Furnace Bridge Wall Company, 149 Broadway, New York.—Models of improved furnace bridge wall.

Wales, Dove-Hermiston Corporation, 17 Battery Place, New York.—Bitumastic and hermastic paints, coatings and enamels.

Wall Rope Works, Inc., 48 South street, New York.—Cordage of all sizes, unspun hemp; Manila hawser 23 inches in circumference, 720 feet long and 5 tons weight.

Waltham Watch Company, Waltham, Mass.—Exhibit of clocks and watches.

Ward Line, foot of Wall street, New York.—Pictures and flags.

Waterbury Company, 63 Park Row, New York.—Cordage of all sizes, unspun hemp; fibre clad wire rope.

Westinghouse Electric & Manufacturing Company, 165 Broadway, New York.—Models of turbines, reduction gears, and other electrical machinery for use at sea; also Diesel electric equipment.

White & Company, Kelvin & Winfred O.—White liquid compass, Lord standard compass, electrically illuminated; pelorus.

Whitlock Cordage Company, Jersey City, N. J.—Manila and sisal rope, plain and tarred; solid and hollow wire rope.

Williams Valve Company, D. T., Cincinnati, Ohio.—Valves of all sizes.

Williams, Wm. E., 62 Front street, New York.—Valves, lubricators, grease cups, electrical drill and grinder, etc.

Wilson Welder & Metals Company, 2 Rector street, New York.—Plastic arc welding units, pyrometers.

Winner Company, 30 Church street, New York.—Steam traps for automatic removal of condensation, or water without waste of steam.

Wireless Improvement Company, 47 West street, New York.—Radio compasses, radio pack sets, arc transmitter, aero type radio equipment.

Worthington Pump & Machinery Corporation, 115 Broadway, New York.—Air compressors, power pumps, condensers, and auxiliary equipment.

Periodicals having booths at the exposition included MARINE ENGINEERING, *Marine Journal, Marine News, Maritime Register, Shipping, Nautical Gazette, Motorship, Shipbuilding Cyclopedia, Shipbuilding and Harbor Construction* (Canadian), *Marine Review, Motorboating,* and *Merchant Marine Manual and Yachtsman's Guide.*

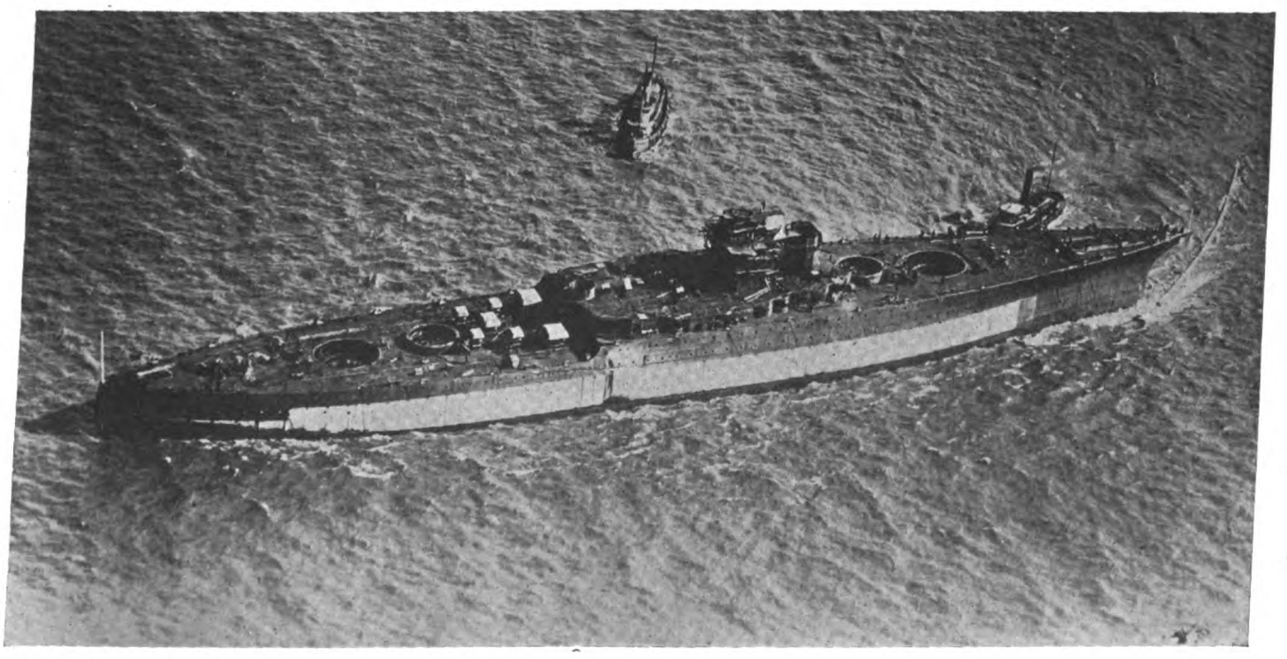
Other booths were occupied by the Travel Club of America, Neptune Association, National Marine League, Seamen's Service Centre, American Red Cross, Young Men's Christian Association, Shipmasters' Club, National Merchant Marine Association, Naval Recruiting Station, Smith's Port of New York Annual, Uttmark's Nautical Academy, American Bureau of Shipping, Seamens Christian Association, W. A. Harriman & Company.

Lloyd's Shipbuilding Returns

LLOYD'S annual shipbuilding return for the past year, which take into account only merchant vessels of 100-tons gross and upwards, that were launched during the year show that the total output during 1919 has been 7,144,549 tons, which is an increase of 1,697,000 tons, as compared with 1918, and 3,811,000 tons more than the output for 1913, which was the pre-war record year.

The countries having the largest amount of tonnage under construction at the end of 1919 are: United States, 2,966,000 tons; United Kingdom, 1,620,442 tons; Holland, 328,000 tons; Italy, 314,000 tons; and Japan, 309,000 tons.

The output in the United States, namely, 4,075,385 tons, is 1,042,000 tons higher than during 1918. The whole of the increase is due to the larger amount of steel steam tonnage launched during the year, which reached about 1,431,000 tons more than during 1918. The wood tonnage, on the other hand, has decreased by nearly 415,000 tons, and is under 13 percent of the total output of the United States as compared with over 31 percent for 1918.



(Photograph by U. S. Air Service from International)

Remarkable Photograph of the United States Battleship *Maryland*, Taken from an Aeroplane Just After the Vessel Was Launched by the Newport News Shipbuilding & Dry Docks Company, Newport News, Va., on March 20

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Two Years of Electric Propulsion on the New Mexico

AS the *New Mexico,* the first United States battleship to be fitted with electric drive, was placed in commission at the New York Navy Yard in May, 1918, she is now just completing her second year of active service. During that time she has seen service of practically every kind that is encountered by a battleship except actual engagement in battle. The results of this service, according to Commander S. M. Robinson, U. S. N., fleet engineer of the Pacific Fleet, of which the *New Mexico* is the flagship, have been highly satisfactory and justify the judgment of those who are responsible for the installation of electric machinery in the vessel.

As Commander Robinson gave a very complete description of the *New Mexico's* machinery in this magazine a year ago, it will be remembered that the electric machinery for propulsion consists of two main turbo generators rated at 11,500 kilowatts each at 80 percent power factor and having an overload capacity of 25 percent, four main motors rated at 7,250 horsepower each and having an overload capacity of 25 percent, two boosters for varying the current of the main field, two 300-kilowatt exciters for supplying the current to the main field and also certain electrically-driven auxiliaries, together with a main switchboard, an exciter switchboard and the necessary wire and cable. The ship uses one generator for speeds up to 17 knots and two generators for speeds from 17 knots to full speed, which is between 21 and 22 knots. For speeds up to 15 knots the motors are run on the 36-pole connection, so that at 15 knots the turbine is running at its designed full speed; from 15 knots to full speed the motors are run on the 24-pole connection. This arrangement gives good economy at all speeds, and in order to give our readers a definite idea of just what results have been obtained, Commander Robinson has prepared the following report:

The *New Mexico* has been operating for nearly a year in company with two sister ships, the *Idaho* and *Mississippi,* which have hulls identical with that of the *New Mexico.* During this time it has been possible to get an accurate comparison of the relative economy of the three ships and also the relative maneuvering qualities. In the latter respect, the *New Mexico* is decidedly superior, and the remarkable part of it is that nearly all the maneuvering in restricted waters has been done with one turbo-generator. When this installation was first proposed, its opponents maintained that, while a ship like the *Jupiter* could be satisfactorily operated with the screws on both sides of the ship running at exactly the same speed, it would not be possible to get satisfactory operation with that arrangement on a ship which had to operate in formation. But exactly the reverse has proved to be true; it has been found that more satisfactory operation is obtained when using one generator than when using two, and it is customary, when in dangerous waters where it is desired to take all possible precautions, to use one generator for driving the ship and to keep the other turning over idle. If the ship is getting under way from an anchorage and has to turn, as soon as the anchor is away the signal is given for standard speed ahead on one side and the same speed astern on the other; with this arrangement the ship will turn absolutely on her heel without gaining ground either ahead or astern; with other engines, where it is not possible to regulate the speed so quickly and accurately, the probability of getting speed on the ship in one direction or the other is much greater. All the predictions in regard to trouble on account of the condition that when operating with one generator the screws on both sides of the ship must run at the same speed (if run at all) have proven to be groundless.

In regard to the comparison of economies the results have been very favorable to the *New Mexico.* The *Idaho* and *Mississippi* are fitted with direct-connected turbines (one is Parsons and the other Curtis) and have geared cruising turbines; the *Idaho* can use her cruising turbines at all speeds up to about 17 knots and the *Mississippi* can make about 15 knots with her cruising turbines. Experience gained by a comparison of destroyers fitted with geared main turbines and those fitted with direct-connected main turbines and geared cruising turbines indicates that the economy of the *Idaho* and *Mississippi* at cruising speeds is about as good as it would be if they had geared main turbines. A comparison of the *New Mexico* with these ships is therefore particularly interesting at the lower speeds.

The advocates of electric propulsion have always claimed that it was very superior to all other forms of propulsion at the cruising speeds, but even the most enthusiastic of these have been surprised by the remarkable showing made. This is doubtless due to the fact that no one made sufficient allowance for the saving due to shutting down one generator and all the auxiliaries that go with one of the condensing plants. At a speed of 10 knots the *New Mexico* uses about 16.7 percent less oil than her sister ships, or, putting it another way, her sister ships use about 20 percent more than the *New Mexico*; at 13 knots the figures are 29.9 percent or 42.7 percent; at 16 knots the figures are 32.3 percent or 47.8 percent; at 19 knots the figures are 28.6 percent or 40.1 percent; at full power the figures are 24.4 percent or 32.2 percent.

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At 19 knots and also at full power the *New Mexico* uses about .975 pound of oil per shaft horsepower, and at 15 knots she only uses 1.1 pounds of oil per shaft horsepower. This is a remarkably uniform economy.

The *New Mexico* has just completed her annual full-power trials and the following table gives an analysis of the data obtained:

	Full Power	Endurance
Revolutions per minute	167.4	151.7
Speed (knots)	21	19.35
Shaft horsepower	28,820	21,650
Pounds of oil per shaft horsepower per hour	.975	.973
Pounds of oil per square foot of heating surface	.506	.3795
Estimated water evaporated in pounds per hour	393,500	294,700
Estimated water per shaft horsepower in pounds per hour (all purposes)	13.65	13.62
Pressure (gage) in pounds per square inch at the boilers	270	265
Pressure (gage) in pounds per square inch at the turbines	255	260
Superheat (in degrees Fahrenheit)	32	23
Vacuum	28.7	29.0

In regard to the reliability of the machinery, the *New Mexico* has had nothing but the most minor troubles with her electric plant and there have been no navy yard repairs whatever; there has been one serious accident to the steam part of the machinery which required work to be done by a navy yard, but that was due entirely to a mechanical defect. Due to improper construction of the main governor, one of the weights became detached while the turbo-generator was running without load; the turbine ran away and operated the emergency governor, which tripped the throttle, but the latter did not entirely close and the turbine ran at over-speed sufficiently to stretch the turbine wheels and the entire rotor had to be replaced. The governor has been changed and additional over-speed protection given by arranging for the emergency governor to close the admission valves as well as the main throttle. The machinery has been in operation nearly a year since repairs were completed and no further trouble has developed.

In conclusion, it may be said that the performance of the *New Mexico* since commissioning has been entirely satisfactory in every way and that the expectations of those who were responsible for its installation have been more than realized.

A Remedy for the Shipping Situation

IN a letter just received from Robert Dollar, head of the Robert Dollar Steamship Lines, the following remedy is proposed for the present shipping difficulties:

"First, change our laws and regulations so as to put our shipowners on an exact equality with their foreign competitors.

"Second, authorize the Shipping Board to sell our ships at the same price as our competitors are paying."

When these two simple propositions are put into effect, Mr. Dollar is confident that we will have a merchant marine in reality.

Mr. Dollar's recommendations are based upon a lifetime's experience in the shipping business and upon a full knowledge of actual conditions as they exist. In the coastwise trade, he says, where the Government can legislate to charge any rates it pleases, the ships can be operated, but in the foreign trade, where competition must be met from every nation which has organizations in every port versed in shipping and backed up by their banks, our Government, powerful as it is, is doomed to failure.

As to the price at which Government-owned vessels should be sold, Mr. Dollar cites a case in which his Canadian company bought two ships from the British Government. This was in October, 1919. One vessel was a twin-screw, 14-knot ship of 13,750 tons deadweight, two years old, which was bought for $111 a ton, and the other a single-screw, 13-knot vessel of 10,750 tons deadweight, one year old, which was bought for $104.50 per ton. If a Shipping Board vessel of, say, 10,000 tons deadweight had been bought for $220 a ton, the difference in price, as compared with a British duplicate, would have been $1,155,000, and in operation the higher-priced American vessel would have had to overcome charges amounting to $195,585 above those required for the British ship. Not only would this difference have to be overcome in order to compete with foreign vessels, but the American ship would also have to carry a 30 percent larger engine room force and pay about 25 percent more tonnage dues and charges on account of the difference in measurement of the competing ships. Other differences must also be reckoned with before the competing vessels are placed on a basis of equality, and it is in view of these at present insurmountable handicaps that Mr. Dollar proposes his remedy.

The Sale of Government Ships

WHILE the recent conferences of heads of large business enterprises of the Middle West on a Shipping Board sales policy was disappointing in that no definite recommendation was made, there were two distinct developments at the meeting which may prove beneficial in establishing an American merchant marine. The first was the unanimous agreement of the members of the conference that the Shipping Board should adopt a scale of prices that would result in the sale of the Government ships to private companies and at the same time protect the investment of the public to the largest extent possible. And the other was the appointment of a committee under the direction of Eugene Meyer, managing director of the War Finance Corporation, to consider means of financing the disposal of the ships.

The sense of the conference was expressed in a resolution that the Board should sell its ships on terms which would assist in the permanent establishment of the merchant marine. It was generally agreed that this should be on the basis of the cost of reproduction less depreciation for age and plus a fair figure for immediate delivery. Among the suggestions which will be considered by the finance committee for submission to the Shipping Board is the formation of a corporation similar to the Railway Equipment Finance Corporation formed by the Railroad Administration to finance the sale of Government equipment to individual railroads. As a result of the difficulty of obtaining funds on reasonable terms for shipping companies, it was realized that a plan should be devised whereby Government credit should be used to assist private companies, but without the need of a further Government expenditure.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Average Life of Punches and Dies

The chart, Fig. 1, shown herewith, was made up from records kept of the number of holes punched by each of several score of punches, together with the thickness of material punched.

Very few of the punches were repaired, as in nearly all cases when a punch broke the fracture was so close to the head that the punch was beyond repair.

In the few cases where a punch could be repaired it was retempered and put back into service. In the chart no account is taken of the repairing, the total number of holes punched up to the time the punch was totally destroyed being the number used in making up the record.

The punches were not all of the same make, and no attempt was made to compare the production of the different manufactures, as it was felt that the conditions under which these tools work are too variable to afford any just criterion of the merits of any one punch.

The records were made from the output of about twenty punches of each size, working on stock material just as it happened to come through the shop. In nearly all cases each punch was used on one thickness of steel.

The quality of steel was in all cases the standard structural steel, and the dies were all 1/16 inch larger in the hole than the diameter of the punch.

The punching was done on a variety of machines, all in fair average working condition, no attempt being made to reach a record number of holes per punch, the idea of making the test being to get a line on what life might be expected from a punch under everyday conditions.

The points in the chart marked with a + represent the average number of holes punched by the punches of the size marked, in the thickness of material shown on the chart. These points are shown connected by straight lines for each individual size of punch.

The table accompanying the chart gives the average number of holes punched by all the punches of each size in all thicknesses of steel. These averages are totaled up and again averaged to show the mean output of all sizes of punches in all thicknesses.

As is well known, the life of punches, even of the same size and working on the same thickness of material, will vary from a few holes up to 20,000 or more. But when it is required to estimate the future needs, this chart will afford a fairly accurate idea as to the number of punches necessary to complete a certain piece of work.

It is interesting to note the marked similarity of the curves for the 11/16-inch and 15/16-inch diameter punches. These show that we can expect the longest life when working on 7/16-inch to ½-inch plate, and that on either thicker or thinner steel the production per punch falls off very rapidly.

The chart shows the life of an 11/16-inch punch in

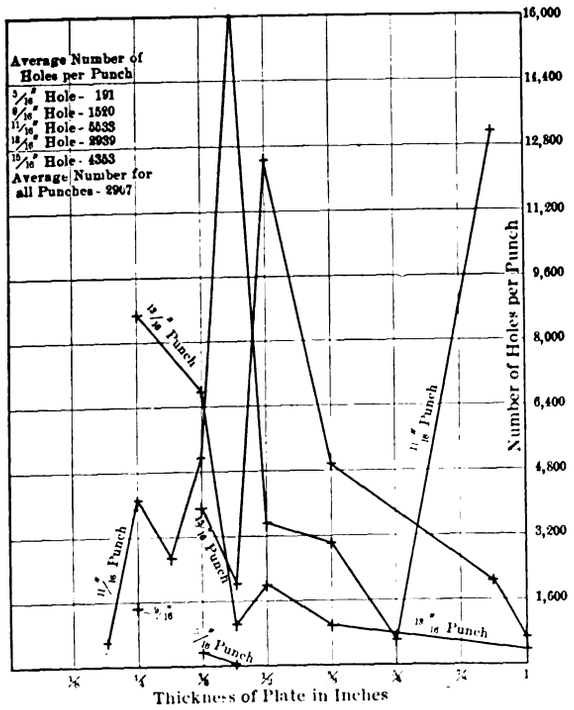
Average Number of Holes per Punch
3/16" Hole - 191
9/16" Hole - 1520
11/16" Hole - 5533
13/16" Hole - 2939
15/16" Hole - 4383
Average Number for all Punches - 2907
Number of Holes per Punch
Thickness of Plate in Inches

Fig. 1.—Chart Showing Average Life of Punches

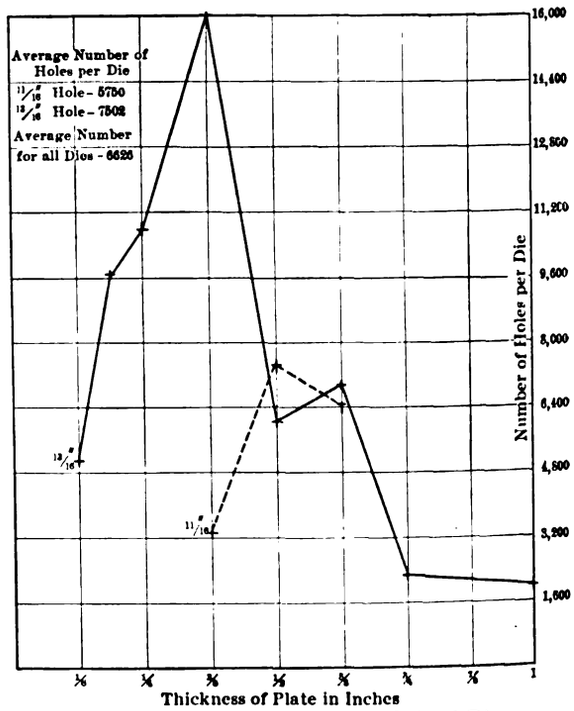
Average Number of Holes per Die
11/16" Hole - 5750
15/16" Hole - 7502
Average Number for all Dies - 6626
Number of Holes per Die
Thickness of Plate in Inches

Fig. 2.—Chart Showing Average Life of Dies

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15/16-inch steel to be 13,000 holes, but this particular number represents the record of only one punch, and is really a rather remarkable performance. If the average life of a number of this size of punch in 15/16-inch steel were available no doubt this quantity of holes per punch would be very considerably less.

The comparatively short life of the 11/16-inch and 15/16-inch punches in thin plates is probably due to the tendency of the plates to stretch under the punch and flow into the die thus jamming the punch.

It would probably be conducive to a longer life of the punch if the die were made only 1/32 inch larger than the punch when working on steel of a thickness of 3/8 inch or under.

Whether this saving in punches would pay for the extra cost involved in handling two sizes of dies for each size of punch will depend upon the kind of work being handled.

Fig. 2 is a similar chart for dies, and what has been written above in reference to the punches is equally applicable to the dies.

New Glasgow, N. S. JOHN S. WATTS.

Scientific Management on Shipboard

Long since, the progressive and successful business man has instituted as a supplementary arm to his regular organization the services of various specialists. Aside from the fact that modern organizations continue this form of service, the fact that the number of firms offering specialized service is rapidly increasing proves that scientific management is very successful indeed.

At the present time the question of the future of the American merchant marine is one of vital importance to everyone in this country. This is a rather broad statement, but it is nevertheless true that every one is concerned, if not directly then indirectly. Operating expenses must be cut to a minimum in order to compete with foreign bottoms. Penny-wise-and-pound-foolish methods must go into the discard. During the war, equipment was standardized as far as possible, consistent with available deliveries, to meet emergency conditions. The object was to make a ship's power plant as simple and foolproof as possible. Now that the emergency is past, why not standardize methods of routine operation? If scientific management pays dividends ashore, why will it not be a paying investment afloat? The purchase of a few instruments and the services of a man familiar with marine operation, who has had scientific training, to instruct the operating force of the ship in their use and who would make a voyage with the ship and lay out a working schedule with the co-operation of the operating chief from the observations made during the trip would be a paying investment to the owner, in the writer's opinion.

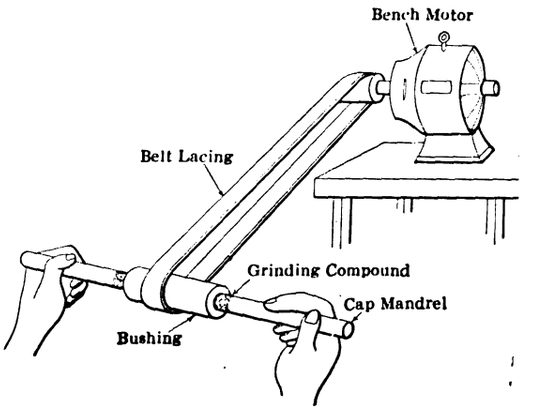
It has been asserted to the writer that the average operating man would not be inclined to co-operate with a specialist in this class of work; but the writer is of different opinion, having been one of the tribe. He can recall an attempt of rough efficiency work on board a well-known liner some twenty years ago. It consisted of the watertender standing on a coal pile in the fireroom and blowing a whistle every time it was necessary to slice fires, calling for odd or even numbered furnaces. Another instance was an old chief who had a set time for overhauling every piece of equipment and kept a record of it. It included valve grinding. That old chief never was caught in a jam at sea; he simply didn't wait for it to happen.

The object of this letter is to create discussion among those interested as to whether or not in their opinion scientific management can do for the power plant afloat what it has done successfully on land. If it can, are we going to let tradition stand in the way of doing our part towards placing the Stars and Stripes on all seas and in maintaining our present state of prosperity?

Long Island City, N. Y. A. POHLMEN.

Lapping Bushings

Here is a simple stunt employed by one of the repair men in our plant to lap in undersized bushings. He obtained a piece of cold rolled round stock of correct diameter and coated the center of it with a heavy mixture of



Handy Method for Lapping Undersized Bushing

compound (emery and cylinder oil) and slipped the undersized pushing over it. As shown in the sketch herewith, by the aid of a belt lacing made into a small belt and a small bench motor, the bushings were quickly lapped to size. This scheme can be employed to good advantage on pulleys, etc., which were found undersized for shafts.

ENGINEER.

Wooden Sectional Floating Dry Dock

I have read with much interest the article by Mr. Carl E. Peterson on "Wooden Sectional Floating Dry Docks" in the March issue of MARINE ENGINEERING and would like to comment on certain statements made therein.

Under "Design and Construction," Mr. Peterson states: "The members of the sections are larely determined empirically and from good practice." Such design usually results in the size of the members being entirely out of proportion to the stresses they are to carry. Frequently these members are much larger than required, and at the same time the joints and connections so proportioned that they can only develop a fraction of the strength of these timbers. This results in needless and excessive first cost and a limited period of service before the dock becomes too limber for safe use. In these times, with the great advancement in engineering, we should be beyond the stage of designing such structures by guess. The forces acting on a floating dock are most definite, and include the weight of the ship on the keel and bilge blocks, the weight of the dock itself, and the upward pressure of the water on the bottom of the dock. With these definite forces to take care of, stress diagrams may readily be drawn, the stresses to which each member will be subjected calculated, and the sizes then determined in accordance with good engineering. Such design results in as-

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sured safety, a longer lifetime, a minimum of material, and a minimum cost. In a floating dock, proper design is as important, if not more important, than good workmanship. Both are essential.

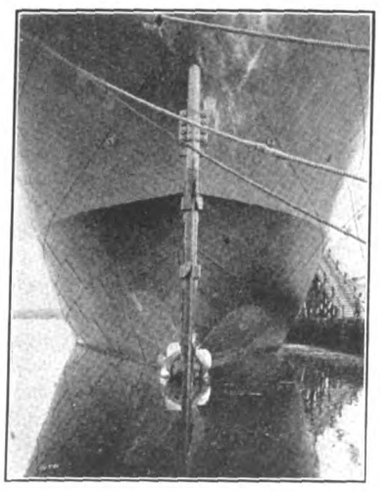
From the subject matter I would assume that Mr. Peterson's remarks cover only the loose-sectional dock. Comparison as to cost is only made with the all-steel floating dock and the graving dock. In the article no mention is made of the effect on the ship in docking in a loose-sectional dock. Anyone who has watched such a dock in operation appreciates that there are frequently wide variations in the rates of pumping and thus in the water levels in the several sections. This results in unequal uplift, all of which must be taken by the ship, causing undue stress and distortion thereto. Self-docking types, such as the longitudinally-trussed sectional dock and the continuous wing-separate pontoon dock, which are usually built of all timber or with timber pontoons and steel wings, do not have this objectionable feature, for the reason that they are designed to withstand longitudinal bending moment as well as lateral bending moment, and thus take care of irregularities of pumping and inequality of load distribution. The former type costs practically no more and the latter but little more than the ordinary sectional dock, and they have practically all the advantages and none of the disadvantages of this type.

East Boston, Mass. J. STUART CRANDALL,
The Crandall Engineering Company.

A Suggestion for the Chief Engineer

You have heard it said that the bronze propellers eat away the stern frame of a steel ship. You probably are familiar with the reasons for such a statement, but in case you are not the following may be of interest, particularly that portion which refers to the method of preventing action between bronze propellers and the stern frame.

Whenever steel and iron and zinc (which constitutes about 40 percent of the metal known as manganese bronze) come in close proximity to each other in a liquid,



Position of Propeller

such as salt water or impure water of any character containing light acids, sewage, etc., an electric battery is created, the action of which is known as galvanic action. This causes the zinc and the iron in very finely divided particles to detach themselves from their respective bodies, thus in time causing noticeable ruptures in the surface of the material.

There is a definite point of distance between two such bodies of metal where the galvanic action ceases, and to prevent the action it is necessary to separate the metals by a greater distance than the minimum referred to.

Practically the entire damage that might occur to the stern frame of a bronze propellered ship occurs when the ship is lying in port and in waters that are decidedly aciduous in composition. In an attempt to overcome this action, zinc plates are many times fastened on the stern frame, and by such an installation of zinc plates the zinc in the bronze is not acted upon, nor is the steel in the stern frame. A better way, however, to reduce the action is to separate the bronze blades from the stern frame by stopping the shaft so that the blades will be in a position farthest removed from the frame. We suggest that you mark your shaft in such a way that when it is registered with any stationary point you may select, the blades are in the position desired, as shown in the illustration, and that whenever you are in port you make it a rule invariably to rest your engine in this position. This will practically eliminate the galvanic action referred to and give greater life to the ship.

This information is furnished by the Columbian Bronze Corporation, manufacturers of Columbian Propellers, 50 Church Street, New York City, in the interests of efficient ship operation.

The Eventful Maiden Voyage of the S. S. William Henry Webb

SO many misleading stories regarding the difficulties encountered by the S. S. *William Henry Webb* (a steel freighter of about 8,800 tons deadweight capacity, built at the Chester, Pa., yard of the Merchant Shipbuilding Corporation, and propelled by Westinghouse geared turbines of 3,000 shaft horsepower) on her maiden trip from Philadelphia to New York have been circulated that the following facts will be of interest to marine engineers.

The ship had passed her trials very satisfactorily and was on her first voyage from Chester, Pa., to New York. Off Atlantic City a stop was made to replace the thrust bearing shoes in the high-pressure turbine, the shoes having wiped, due to dirt and foreign matter in the oil, which had not been filtered out. Spare thrust shoes were quickly fitted and the vessel proceeded.

The real trouble came later, when water in some way became mixed with the fuel oil supply to the boilers and caused the fires under the boilers to go out. Thereupon followed a strenuous time ascertaining the source of the water leak into the fuel oil and attempting to get up steam again. The troubles were aggravated about this time by a fire which broke out in the fireroom. This, however, was quickly controlled and put out before any particular damage had been done. The ship, being unable to make headway during this time, anchored, and radio messages were sent out for assistance. The steamship *Panama* stood by and towed the vessel to Ambrose Light, where she was taken in charge by tugs.

The source of the trouble with the fuel oil is unknown, and opinions regarding it vary considerably. The ship itself is one of a standard type, of which a number are in commission, and none of which has ever had trouble of this nature before. The troubles with the *William Henry Webb* were not due to the engines or the boilers, and outside of the wiping of the high-pressure turbine thrust bearing shoes it is stated that the main turbines and gears had given perfect satisfaction.

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Questions and Answers for Marine Engineers

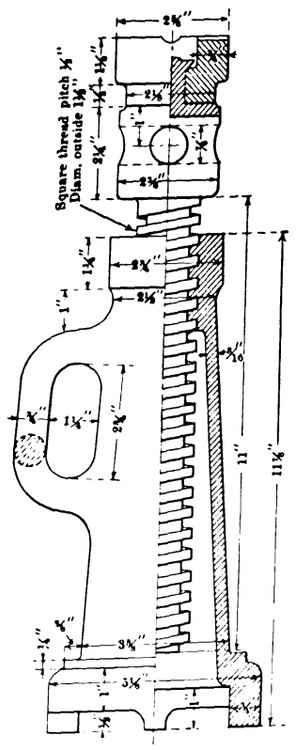
Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Design of Jack Screw and Pillow Block

Q. (1033).—I enclose sketch of a screw jack and would like to know how I could get a table of measurements of two screw jacks of different diameter and pitch; also measurements for pillow blocks for 2-inch and 5-inch shafts. If there are any books on the subject, please let me know. J. S.

A. (1033).—For a description of the proper method of designing jack screws, I would refer you to "Machine Design, Hoists, Derricks and Cranes," by Hess and published by Lippincott Company (1912, page 193), from which some of the matter below is taken.



Sketch of Screw Jack, Showing Dimensions

The screw is subjected to a combined stress, namely, compression and shearing, which can be calculated by the following formula:

$$f = \tfrac{3}{8} f_c + \tfrac{5}{8} \sqrt{f_c^2 + 4 f_s^2}$$

The pressure on the projected area of the thread should be limited to 1,000 pounds per square inch for a brass nut and 700 pounds per square inch for cast iron. Below is given a table of the principal dimensions of several jack screws, the last two columns being from the catalog of Cameron & Barkley Company:

Diameter of Screw, Inches	Height of Jack Closed, Inches	Rise of Screw, Inches	Capacity, Tons
1¼	4	1½	10
1½	6¾	2½	12
1¾	8	3¼	16
2¼	16	9	24

It would appear that the jack screw shown in your sketch was for lighter service than indicated by the corresponding size in your table. In criticism of the former jack screw it is only fair to say that the thickness of the base appears too thin for cast iron, namely, 5/16 inch. Twice that value would appear more reasonable to the writer. In some cases the nut is of wrought steel and bears in part against a steel band shrunk on the upper portion of the cast iron base, serving thereby better to support the latter. In the design shown in the sketch the screw works in the threaded part of the base, which appears to be of cast iron. The diameter of the screw will usually determine the capacity of the jack. The pitch of the screw can be made that for standard square thread.

Since it is not stated what service the pillow blocks (which you wish dimensions of) are called upon to perform, it would perhaps be best to refer you to books on machine design which give proportions of bearings (based on diameter of shaft) with a description of their adaptability to particular service; therefore, see Hess' "Machine Design," Spooner's "Machine Design, Construction and Drawing," Marks' "Mechanical Engineer's Handbook."

Scaling Batten

Q. (1037).—What is the best method of scaling a wooden ship or, in other words, to lay out a scaling batten. E. E. E.

A. (1037).—If by "scaling batten" you refer to the batten used in laying off the width of the various planks, you will find a very good detailed account of laying out the planking, including lifting a spiling, in "A Practical Course in Wooden Boat and Shipbuilding," by Van Gaasbeek, page 78, published by F. J. Drake & Company, Chicago.

Packing Material

Q. (1038).—What is the best material to use as packing (in the form of grommets) under the washers placed under the bolt heads of a joint like the main steam line, where flanged and bolted to the boiler mountings for permanency and tightness? The following have been used:

1. White lead on asbestos wicking.
2. White lead on cotton (lamp) wicking.
3. Strands of ordinary steam valve packing.
4. A small quantity of magnesite, which has worked well in the past.

Is it advisable and according to best practice to use such grommets under bolt heads and washers for such joints? K. W. W.

A. (1038).—The joint of the main steam pipe or stop valve to the boiler nozzle should be tight enough so that the bolts would not require washers and grommets. I have found that magnesite has worked very well on joints of this character. Should a joint start blowing around a bolt, a temporary repair can be made by either of the combinations you suggest, the latter being perhaps preferable; either of the first three would require following up or tightening from time to time.

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Shipbuilding and General Marine News

Contracts for New Ships — Shipyard Improvements — Engineering Projects—Improved Appliances—Personal Items

AMERICAN SHIPBUILDERS FORM AN ORGANIZATION

Publicity To Be Relied Upon To Foster Maritime Interests—No Lobby Planned—Permanent Merchant Marine the Object

The committee of American Shipbuilders, appointed at a meeting in this city last March, through its chairman, J. W. Powell, vice-president of the Bethlehem Shipbuilding Corporation, Ltd., has given out the following statement:

"Shipbuilders of the United States, including representatives of Atlantic, Pacific, gulf and lake yards, have formed an organization for the purpose of making secure the future of the American merchant marine.

"This movement has the authority of a representative meeting of shipbuilding interests held in New York in March. The committee to-day announces its membershiip and plan of action.

"The committee of American Shipbuilders will conduct no lobby. It will set forth its views mainly by the use of newspaper advertising space. The origin and responsibility for anything it may issue will be clearly stated. It will derive its funds from subscriptions by shipyards based on the average number of employes. The committee's records of its activites and expenditures will be open at all times to every one interested.

"There is evidence on all sides that the American people of all sections and political creeds unite in the belief that an American merchant marine is a necessity, both from the viewpoint of national safety and economic welfare. This belief is deeply rooted in history, in our own experience, and was only emphasized anew when the world war found the United States lacking in the means of transporting either its troops or its products.

"With the greatest foreign trade, the longest seaboard, the largest resources of shipbuilding materials, and the traditions of a nation which had once dominated in the world's sea carriage, the United States shipping had before the war sunk to a point where only 9 per cent of our trade was carried in American ships. Periodically there was discussion of means to end this humiliating situation, but no offensive measures were taken to correct it.

"The need now is to decide what shall be the future of the great commercial fleet built by the Government at a cost of $3,000,000,000. The fate of the shipbuilding industry created during the war; the shipping legislation pending in congress and the demand of the entire country that the United States shall not sink back into a position of inferiority on the seas, are among the reasons why it is believed that a decision as to our shipping policy must be taken.

"It is not believed that a wise decision can be made as to the sale of United States owned ships until measures have been taken which will make it possible to operate these ships profitably. Lacking such measures our fleet will soon pass to foreign ownership or disuse.

"The disadvantages under which American shipping labors and which resulted in the decay of our merchant marine before the war still exist.

"The principal disadvantage is the higher cost of American shipbuilding and operation. It is not possible or desirable to reduce the standards of American wages and living, either in our yards or on our ships. Other measures must therefore be adopted.

'The committee of American shipbuilders will set forth the facts of the situation as it sees them, confident that Congress will take such steps as may be necessary, not merely to protect the shipbuilding industry, but, for the good of the country as a whole, to place the existing and future American merchant marine upon a safe and permanent basis."

The committee is composed of J. W. Powell, vice-president Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., chairman; H. B. Taylor, vice-president William Cramp & Sons Ship and Engine Building Company, Philadelphia; H. A. Evans, president Baltimore Dry Dock & Shipbuilding Company, Baltimore; A. C. Pessano, chairman Great Lakes Engineering Works, Detroit; J. W. Mason, president Western Pipe and Steel Company, San Francisco; J. F. Duthie, president J. F. Duthie & Co., Seattle; Henry C. Hunter, secretary, 30 Church street, New York.

FIVE TANKERS BOUGHT

Frankel Brothers in Alliance With Oil Concern

The Universal Transportation Company, Inc., and Frankel Brothers, 26 Beaver street, New York, have purchased a substantial interest in the United States-Mexican Oil Corporation, which is said to own more than 50,000 acres of oil lands in the United States and Mexico, with a number of producing wells, and more being drilled.

The oil corporation has just purchased five tank steamers, built by the Terry Shipbuilding Company, of Savannah, at a price said to be $225 a ton, and is negotiating for more vessels of the same class. One of the vessels is to be delivered right away and the others at intervals of six weeks. The carrying capacity of the five will be 1,500,000 barrels.

The company has been operating chartered vessels in the execution of a coal contract with delivery at Marseilles and doing a general cargo business in other trades. These having been completed it is now proposed to enter the oil trade.

Duthie Building Big Towing Vessels

Keels have been laid at the J. F. Duthie & Company shipbuilding plant, Seattle, Wash., for two 2,650-ton steel ships, ordered by James Griffith & Sons. With 1,000 men at work it is expected they will be ready for launching by June 1. One vessel was ordered for the Coastwise Steamship & Barge Company, one of the Griffith subsidiaries, and will be used in coast trade. The other will be sent to England to establish a barge towing service in the coal trade from Wales to northern France. Both vessels will be equipped with powerful towing machinery.

Old Dominion Steamers for Auction in England

The four steamers of the Old Dominion Steamship Company are to be put in the hands of an English auction house, it is learned. They are the *Madison*, 3,734 gross tons, built in 1911; *Jefferson*, 3,723 gross tons; *Hamilton*, 3,723 gross tons, and *Jamestown*, 2,898 gross tons. The *Jefferson* and *Hamilton* were built in 1890. The *Madison*, *Jefferson* and *Hamilton* have accommodations for 150 first-class and 300 steerage passengers. The *Jamestown*, built in 1894, has accommodations for 100 first class passengers and 175 in the steerage.

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CONTRACT FOR TEN TANKERS GOES TO SEATTLE BUILDERS

David Rodgers Will Keep Former Skinner & Eddy No. 2 Yard Busy—Ten More Ships Likely When Present Contract Is Completed

Statements that David Rodgers, of Seattle, whose new company recently purchased the No. 2 Skinner & Eddy plant from the Emergency Fleet Corporation, has enough work in sight to keep the plant going indefinitely, have been inspired by the announcement just made that the American Fuel Oil & Transportation Company, 111 Broadway, New York, has awarded a contract for the construction of a fleet of ten 10,000 deadweight ton tank steamers to the new company. Keels for the first five will be laid promptly, and it is intended to speed up production. Details as to size and cost have not been given out.

There are five modern ways in the No. 2 Skinner & Eddy plant, as it is known to the shipbuilding world, and the yard has a record for speed construction. It has completed its contract for the Emergency Fleet Corporation and has just been turned over to the new owners. Upon the completion of the first group of ten ships it is said that there is a likelihood of an additional block of ten tankers being placed.

The yard covers 17 acres and its ways are large enough for ships of 10,500 deadweight tons. Other facilities were acquired when the plant was purchased from the government at a cost of more than $3,000,000.

It was reported that the deal was financed here by the Irving National Bank, Woolworth Building.

PLENTY OF WORK IN SIGHT

New York Shipbuilding Company Makes Favorable Report

The New York Shipbuilding Company, which has under construction sixteen of the new 855 feet passenger liners for the Shipping Board, had $94,000,000 in ship production under way on December 31, according to the annual report for 1919, just made public. In addition to the Shipping Board order, the company is engaged upon work on twenty torpedo-boat destroyers and two battleships—the *Colorado* and *Washington*. The keel for the battle cruiser *Saratoga* will be laid this summer.

The growth of the plant was shown by the statement that the working force numbered at the end of 1919, 17,500. It was only 12,000 at the end of 1918 and 4,500 in December, 1916. Of this number 3,500 are employed in the South Yard, the construction of which was arranged by the Emergency Fleet Corporation. The plant, which consists of four large building ways, with appurtenant shops and power plant, has been taken over by the company on a profit sharing basis, it was announced.

In addition to the work being done for the Government the company is building four oil tankers for American interests and two for the company's account. President Marvin A. Neeland stated that the corporation had orders in hand sufficient to keep it in operation well into 1921.

Two Ships Made Into One

Admiral Sir Reginald Bacon has revealed a naval secret of the war concerning two British destroyers of the Tribal class. One was the *Zulu* and the other the *Nubian*. They were seriously damaged in the bow and stern, respectively, by mines. Instead of regarding them as losses, shipbuilders took them in hand, and the sound ends were joined together and a new ship turned out. The names of the original vessels were combined in naming the new one *Zubian*.

TO BUILD $500,000 YACHT

Great Lakes Engineering Works Gets Dodge Contract

The contract for the construction of a 257-foot steam yacht for Horace E. Dodge, of Dodge Brothers, the Detroit automobile manufacturers, has been awarded to the Great Lakes Engineering Works, of Detroit, Mich. It is understood that the boat will cost about $500,000.

The boat was designed by Henry J. Gielow, of 52 Broadway, New York, who will have supervision of its construction. The hull is to be of steel 257 feet 8 inches in length, with beam of 35.5 feet. Driving power will be furnished by two quadruple expansion engines of 1,500 horsepower each, steam for which will be supplied by three Babcock & Wilcox boilers.

May Scrap the St. Louis

The American liner *St. Louis*, after a service of twenty-five years as a trans-Atlantic vessel, has been turned over to the underwriters by the International Mercantile Marine Company, 9 Broadway, New York, to be sold or sent to the scrap heap, as their ship construction experts may deem fit.

The liner, as the *Louisville*, had carried American troops through the submarine and mine zone during the world war, and was just being turned into a passenger liner again when she caught on fire at Fletcher's Dry Dock, Hoboken, on January 9 last, and was practically gutted.

SHIP SALES CONDITIONS

Terms Announced on Which ex-German Ships are Sold

The conditions laid down by the Shipping Board in connection with the purchase of the ex-German passenger ships recently offered for sale by the Board are as follows:

1. That under contract the operator will recondition at his own expense and responsibility.
2. Reconditioning plans and specifications to be approved by the Shipping Board.
3. Route proposed to be approved.
4. Interest of operator in any given passenger service to be at least 30 per cent. of the venture.
5. Management and operation to be unrestricted.
6. Compensation to be deducted from gross income on basis of 5 per cent. of gross receipts less any other agency commissions paid.
7. Value of ships in present condition to be agreed upon.
8. Operator agrees to buy and Shipping Board agrees to sell when legal obstacles are removed.
9. Until legal obstacles are removed and transfer of title made, profit or loss to be divided between Shipping Board and operator in same proportion as their respective interest may appear and for a period of at least five years.
10. No change of flag would be considered.

Launched at Midnight

A novel event in the history of shipbuilding at Thomaston, Me., was the launching at midnight recently of the schooner *Lloyd W. Berry*, built by Charles A. Morse & Son for Roger Griswold and Captain Harold Peters of Boston. The schooner measures 69 feet over all, is rigged as a fisherman, but will be used in general trade, possibly in the West Indies, under the command of Captain Peters. She cost about $6,000 and hails from Bangor.

To Buy Large Freighters

The General Steamship Company, a new Seattle, Wash., organization, has its service to South America well under way, a steamer having just reached por with a cargo from ports south of the equator.

Announcement is made that the company is preparing to buy a number of large freight steamers.

Inspectors Wanted

The U. S. Civil Service Commission announces open competitive examinations to be held May 5 and 6, June 9 and 10, for local and assistant inspector of boilers and for local and assistant inspector of hulls in the Steamboat Inspection Service. Application blanks may be obtained from the local secretary of the U. S. Civil Service Board at the post offices of the principal cities.

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FOX SYNDICATE BUYS MORE EX-GERMAN SHIPS

Purchases For Consolidated Maritime Lines Aggregate About $15,000,000—Vessels All Disposed Of By Shipping Board

Following up their previous purchase of seven of the ex-German vessels held by the Shipping Board, Victor S. Fox & Company, Inc., of 47 Broadway, and their associates, bought from the Shipping Board on Saturday, April 10, vessels aggregating 50,000 additional tons, for the Consolidated Maritime Lines, recently incorporated with a capital of $10,000,000. The additional steamers are the *Eastern Queen*, 9,062; *Jeannette Skinner*, 8,860; *Eastport*, 6,820; *Castlewood*, 4,050; *Liberty Land*, 7,800; *Coosa*, 2,025, and *Armenia*, 7,550 deadweight tons. The *Coosa* is an ex-German and the *Armenia* an ex-Austrian.

According to an officer of Victor S. Fox & Company, the ships purchased from the Shipping Board for account of the Consolidated Maritime Lines now totals fourteen. The following seven were purchased two weeks ago: *Isonomia*, 6,020; *Arapahoe*, 300; *Tonawanda*, 2,847; *Chillicothe*, 3,500; *Moshulu*, 4,950, and *Muscota*, 3,750 deadweight tons.

Of the steamers purchased, two, the *Eastern Queen* and the *Westport*, were built in Japanese yards.

Commenting on the transaction the official of Victor S. Fox & Company said that the cost of the fleet will be about $15,000,000. He said the enterprise has contracts to carry large quantities of grain and coal to Mediterranean and Black Sea ports, and eventually general cargo services from United States ports to the Mediterranean and Black Sea and South America and the West Indies will be established.

Victor S. Fox, who, with A. G. Lampke, of Lampke & Stein, general counsel for Victor S. Fox & Company, conducted the negotiations with the Shipping Board, issued a statement to the effect that he was making arrangements for the taking of further Board tonnage. He expressed confidence that the Board's policy of encouraging those who invest in its vessels would result in the assignment of a large amount of Shipping Board tonnage to the Consolidated Maritime Lines for management. His estimate on this point was 200,000 tons.

The ships already acquired were bought on the new charter purchase plan. Initial payments made were said to have amounted to more than $1,000,000.

WASHINGTON, April 11.—At an auction held at the Shipping Board offices on Saturday the seven remaining ex-German cargo vessels were sold. The Board has now disposed of its entire list of 34 former enemy vessels. The only ex-German vessels left which might be classed as freighters are a small ship of 600 deadweight tons and a wooden sailing vessel.

RECONDITIONING SHIPS

Navy Doing the Work on Recent Contracts

The *Powhatan*, formerly the ex-German liner *Hamburg*, which was disabled when 350 miles from Halifax, has been turned over to the Shipping Board by the War Department, and will be put into commercial service as soon as she is re conditioned. The vessel is being surveyed preliminary to being sent to the Brooklyn Navy Yard.

The *Powhatan* has a gross register of 10,531 tons, and had accommodations for 1,382 passengers. She is 500 feet long and has a speed of 16 knots.

When the ex-German ships were put up for sale the *Powhatan* was assigned to the Baltic service, but did not attract any bidders. It is reported that some American interests are seeking to obtain her for the Mediterranean trades.

There are several ex-German and former Austrian ships now under repair and reconditioning. The *Huron*, *Aeolus*, *George Washington*, *Martha Washington* and *Agamemnon* are being refitted. The *Susquehanna* and *Callao* are in commercial services. It is stated that the government is in a quandary as to what it will do with the *De Kalb*, which was badly damaged by fire, as it is felt that the cost of converting her into a first-class passenger liner will be excessive.

The Army retains control of the *Mount Vernon*, *America*, *Mercury*, *Pocahontas*, *Princess Matoika*, *President Grant* and a few other vessels which would be valuable as passenger carriers if they were reconditioned.

The most recent contracts have been made with the Navy on a time and material basis, private companies not having had an opportunity to bid.

England Buying Ship Plates in Canada

An order has been placed for ship plates in Canada by the British firm of Armstrong, Whitworth & Co., Ltd., of the Elswick Works, Newcastle-on-Tyne. The original quantity wanted by the English concern was 20,000 tons, but it was found impossible to supply the entire amount from the Sydney, N. S., mill of the Dominion Steel Corporation, on account of the pressure of other business, notably the plates being supplied under contract for the Canadian Government, which amounts to 50,000 tons per year, and will be increased to 75,000 tons. The mill at Sydney has a capacity of 100,000 tons of plates per year.

Advantages of Electric Soldering Iron

The electric soldering iron, when compared to the type heated in a gas flame or fuel-burning muffle, exhibits improvements, both in operation and convenience which should make its adoption in shops where soldering is carried on a matter of serious consideration.

The ordinary type iron is, as a rule, anything but economical, either from the standpoint of time or of material. It requires continual reheating, since it chills very quickly from radiation, and

A Special Feature of the Electric Soldering Irons Is Its Flexible Handle

nearly every time it is reheated the tinning is destroyed. The electric iron, on the other hand, once heated remains hot as long as it is needed, but does not become hot enough to oxidize the tinning or the copper.

Due to the fact that it does lose heat rapidly, the average soldering iron is made with a very large, heavy copper element, usually none too securely fastened to an iron rod having a light, wooden handle. As a consequence, the iron is hard to use because of its lack of balance. For working in corners or narrow places a skilled operator is required to manipulate it with any degree of success.

To overcome this awkwardness, the General Electric Company, Schenectady, N. Y., has developed an electric iron having a heavy spiral wire handle, which allows a certain degree of flexibility, while giving the iron a good balance and a firm connection to the copper.

Other features of the gas-heated iron make it more or less undesirable, and among these is the fire risk. Gas flames are subject to blowing back and exploding.

The average fuel-burning muffle is at best smoky, inconvenient and far from economical. There is always danger of the iron rolling off a bench if laid down for a minute and starting a fire.

The electric iron can be quickly attached to any lighting circuit and a constant heat is assured. The spiral handle is expanded into a guard ring where it joins the tip, so that the heated part of the iron is raised when the iron is not in use. This feature removes the fire hazard.

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Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIP CONTRACTS

Freighters, Seattle, Wash.—J. F. Duthie & Company will build two small freighters of about 1,600 deadweight tons each for their own account.

Converting Steamers, Boston, Mass.—The steamers Governor Cobb and North Land, of the Eastern Steamship Lines, will be converted from coal to oil burners.

Barges, Rondout, N. Y.—Bernard J. Donovan has a contract with New York parties to build four barges to be delivered by June 1. Each barge will be 110 feet long and 33 feet wide.

Ferryboat, Boston, Mass.—Fay, Spofford & Thorndike are to design the new ferryboat, for which $400,000 of the budget of the city of Boston is to be spent to relieve the ferry service to East Boston.

Steamers, New Orleans, La.—Keels have been laid by the Doullut & Williams Shipbuilding Company for the fifth, sixth and seventh hull of the 9,600-ton ships contracted for by the Shipping Board.

Tankers, Everett, Wash.—The Norway-Pacific Shipbuilding Company has closed a contract with the Norwegian Tankers Company, Ltd., of Christiania, for five 10,600-ton tank steamers, totaling $11,000,000.

Reconditioning Ex-German Ships.—A permanent injunction has been made against the sale of the ex-German passenger vessels by the United States Shipping Board. The board has decided to proceed with reconditioning these ships.

Steamers, Wilmington, N. C.—Upon the completion of three 9,600-ton steamers contracted for by the Shipping Board, the George A. Fuller Company will begin the construction of steel ships on its own account at the Carolina yards.

Tankers, Oakland, Cal.—Contract has been placed by the Shell Company of San Francisco with the Union Construction Company for one 10,600 deadweight tons tanker, and by the Standard Oil Company of California with the same builder for an oil carrier of about 2,000 tons.

Conversion of Destroyers, New London, Conn.—The turbine-driven American torpedo boat destroyers Reid, Flusser, Preston and Lawson are to be converted into Diesel-driven passenger vessels and private pleasure crafts by the New London Ship and Engine Company.

Steam Lumber Carrier, Hoquiam, Wash.—Contract for the construction of a steam lumber carrier for the Hart-Wood Lumber Company has been closed with the Matthews Shipbuilding Company. The vessel will be built at the Peninsula Shipbuilding Company's plant, and will be named the Quinault.

Steel Steamers, Pensacola, Fla.—The Pensacola Shipbuilding Company has contract for the construction of six 9,000-ton steel steamships for English buyers. The contract calls for vessels 402 feet in length, 36 feet breadth and 24 feet depth, to be fitted with Scotch boilers and reciprocating engines.

Freighters, Newark, N. J.—The Submarine Boat Corporation will build for sale twenty freighters of 9,000 deadweight tonnage, with a speed of 12 knots and a draft of about 25 feet; propulsion will be either by steam or Diesel engines, and probably some will be equipped with internal combustion engines.

Passenger and Cargo Ship, San Francisco.—It is reported that the Matson Navigation Company, if it fails to secure a vessel from the Shipping Board, or in the market, plans to let contract for building a vessel equipped with deck hatch and side port openings for Pacific trade. The company at present has two large freight carriers under construction.

Equipping Ships, Coos Bay, Oregon.—The Pacific Marine Ironworks has contracts for equipping three Oregon built ships. Two of the vessels are at the yards of Kruse & Banks, on Coos Bay. Contracts for boilers, engines and machinery run between $140,000 and $150,000 on each ship. The third contract is for the vessel to be built for the Hartwood Lumber Company.

Tanker, Oakland, Cal.—A contract to build a bulk oil carrier of 16,340 deadweight tons capacity has been awarded to the Moore Shipbuilding Company by the Southern Pacific Company, Pier 49, North River, New York. The vessel will be 535 feet over all in length, 71 feet beam, 39 feet depth, and 23,000 tons displacement, and will carry 125,000 barrels of crude oil.

Towing Steamers, Seattle, Wash.—Keels have been laid at the J. F. Duthie & Company shipbuilding plant for two 2,650-ton steel towing ships, ordered by James Griffith & Sons for launching June 1. One vessel will be for the Coastwise Steamship & Barge Company, one of the Griffith subsidiaries, and the other will establish a barge towing service in the coal trade from Wales to Northern France.

Completing Hulls, Portland, Oregon.—It is proposed to purchase a number of unfinished hulls from the Shipping Board, which will be converted into six-masted schooners. The money has been raised by popular subscription and the craft will be used to carry timber products of the Columbia River district. Cost of each craft estimated at $150,000. Capacity, 2,000,000 feet of lumber.

Tankers, Seattle, Wash.—The American Fuel Oil & Transportation Company, 111 Broadway, New York, has awarded a contract for the construction of a fleet of ten 10,000 deadweight ton tank steamers to the new David Rodgers Company, which has bought the Skinner & Eddy No. 2 yard. Keels for the first five will be laid promptly, and it is intended to speed up production. Details as to size and cost have not been given out.

Tankers, Seattle, Wash.—The Skinner & Eddy Shipbuilding Company will build a 13,500-ton bulk oil carrier for Knute & Knutsen, representing Norwegian interests. Contract for engines, which will be 3,600 horsepower, not awarded; contract for three boilers, 15 feet 9 inches in diameter and 12 feet 2 inches long, awarded to Commercial Boiler Works of Seattle. Other contracts are expected, according to D. E. Skinner, president of the company.

Converting Steamer, South Freeport, Me.—At the yard of the South Freeport Shipbuilding Company one of the three Ferris-type steamers contracted for by the Shipping Board, which was about 40 percent completed when work was stopped, has been bought by the builders, who are making it o er into a four-masted schooner. It will be ready for launching by mid-summer, at which time the keel for a four-masted schooner of about 1,200 tons will be laid.

Reconditioning the Leviathan.—Specifications for the reconditioning of the Leviathan will be sent to prospective bidders. The Shipping Board intends to open the bids on May 1. Plans provide for making of the ship into one of the finest modern passenger vessels, estimated cost of reconditioning being around $6,000,000. The board seeks a lump-sum offer, and has decided against a cost plus contract. Specifications will be sent to any responsible company asking for them. The navy also will bid.

Tankers, Mobile, Ala.—According to Birmingham, Ala., advices, the Mobile Shipbuilding Company has an offer from British interests for the building of twenty large steel tankers, and will accept the contract if the Birmingham Steel Corporation, which is the fabricating plant of the shipbuilding company, secures the material. It is announced that approximately $10,000,000 is to be spent toward increasing the output of steel for use in the Mobile company's yard. Plans are being drawn for the vessels in the British contract.

Tankers, Shooters Island, N. Y.—On April 19 keels were laid for two of the four 8,400-ton oil tankers which the Standard Shipbuilding Corporation is building for the Eagle Oil Transport Company, Ltd., of London. The berths were decorated with American and English flags, and while the first rivets were being driven the Standard Shipyard Band played appropriate American and British airs. These ships are being built on the Isherwood system, will be 427 feet long, 53 feet 1 inch beam and 24 feet depth, and will have a speed of eleven knots.

Yacht, Detroit, Mich.—Contract for the construction of a 257-foot steam yacht for Horace E. Dodge, of Dodge Brothers, Detroit automobile manufacturers, has been awarded to the Great Lakes Engineering Works, of Detroit, Mich. It is understood that the boat will cost about $500,000. It was designed by Henry J. Gielow, of 52 Broadway, New York. It is to be of steel, 257 feet 8 inches in length, with beam of 35.5 feet. Two quadruple expansion engines of 1,500 horsepower each, with steam supplied by three Babcock & Wilcox boilers will be the propelling power.

Schooners, Maine Ports.—Contracts have been made for building a number of four-masted schooners in ports of Maine, majority ranging from 1,000 to 1,300 tons. The East Coast Ship Company, Boothbay, will build one, the Atlantic Coast Company, of the same town, two, both for Crowell & Thurlow, Boston; Russell Shipbuilding Company, Portland, two four-masters; Cumberland Shipbuilding Company, Portland, two; and the Bath district, an indefinite number, but including two five-masters; four-masters are to be built at Rockland, Thomaston and Harrington, while at Machias two, or possibly three, vessels of the same type will be built this year.

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SHIP YARDS AND DRYDOCKS

Groton Iron Works, Groton, Conn.—Having made satisfactory settlements with their creditors, the Morse interests are again in full charge of the plant.

Plate Shop, Newburgh, N. Y.—The Newburgh Shipyards Company, Newburgh, N. Y., has plans for building a plate shop fitted with overhead cranes and modern machinery, and estimated to cost about $350,000.

Shipyard Purchased, Port Jefferson, N. Y.—The Bayles Shipyard was sold by the Shipping Board to the New York Harbor and Dry Dock Company for $2,025,000. Previous sale to A. P. Allen canceled, as terms were not complied with.

Marine Railway Company, St. Andrews, Fla.—Capitalized at $50,000, the St. Andrews Marine Railway Company has organized and applied for patents. The principal business is to be construction of ships, repairs to vessels, and the like, and to construct, maintain and operate a marine railway. W. D. Miller, West Bay, is president; W. E. Tiller, St. Andrews, secretary and treasurer; W. S. Moates, St. Andrews, vice-president.

PORT IMPROVEMENTS

Quays, Baltimore, Md.—The quay system has been suggested in the development of the harbor under the $50,000,000 port loan provisions.

Bulkhead, Etc., Hammond, Oregon.—The town has voted $50,000 bonds to build bulkhead and reclamation work along the Columbia River.

Swan Island Basin, Portland, Oregon.—Unanimous approval of the Swan Island basin improvement project has been made by the Commission of Public Works.

Terminals, Wharves, Etc., Jacksonville, Fla.—City Commission plans to construct wharves, railroad terminal facilities, warehouses; estimated cost, $2,000,000.

Dredging and Excavating, Buffalo, N. Y.—United States Engineer Office, 540 Federal Building, rejected the only bid received March 17 for dredging and rock excavating in Black Rock Channel.

Improve Ferry Service, East Boston, Mass.—A bill allowing the city to borrow $1,000,000 outside the debt limit for improvements of the East Boston ferry service was passed, to be engrossed April 9.

Dredging, Buffalo, N Y.—G. H. Norton, City Engineer, let contract for dredging in Buffalo inner harbor to the Great Lakes Dredging and Dock Company, Morgan Building, $.0335 per cubic foot.

Lock and Esplanade, Florence, Ala.—United States Engineer Office rejected the only bid received, January 2, for building a lock and esplanade at Widows' Bar, Tennessee River, near Bridgeport.

Bulkhead, Quincy, Mass.—Application to build a bulkhead and fill Bent's Creek has been made by the Fore River plant of the Bethlehem Shipbuilding Corporation, Ltd., to the State Department of Public Works.

Dredging, Detroit, Mich.—Sealed proposals will be received at the United States Engineer Office until 11 A. M., May 5, 1920, for dredging in St. Clair River at Port Huron, Mich. Further information on application.

Piers, Seattle, Wash.—The Union Oil Company of California plans to extend Pier 18 a distance of 250 feet, also tear down temporary dock and build pier 450 feet long and 50 feet wide. Cost between $175,000 and $200,000.

Jetties, Portland, Oregon.—The removal of jetties in Williamette Slough and opening the slough to steam navigation has been recommended by the Government Engineer in charge of channel work in the river below Portland, Oregon.

Dredging, Tacoma, Wash.—The dredging of the Tacoma waterway to a depth of 30 feet up to Eleventh street bridge will be recommended to the Government by Lieut.-Col. J. A. Woodruff, United States Engineer Office, Tacoma district.

Improving Wharf, New Orleans, La.—The Dock Board will make extensive improvements on the Poydras street wharf, including the building of sheds, a mezzanine floor, etc.; estimated cost for additions and improvements about $559,000.

Dredging, Philadelphia, Pa.—The United States Engineer Office, 815 Witherspoon Building, let contract for dredging in the Delaware River, Philadelphia Harbor, to the American Dredging Company, Mariner & Merchant Building, $519,639.

Dredging and Rock Removal, Hudson River.—United States Engineer Office, 39 Whitehall street, has let contract for dredging and rock removal in Hudson River to the Great Lakes Dredging and Dock Company, 17 Battery Place, New York, $656,978.

Pile Wharf, Dredging, Boston, Mass.—Plans have ben filed by Simpson's Patent Dry Dock Company, of East Boston, with the State Department of Public Works, Division of Waterways and Public Lands, and application made for a license to build a pile wharf and to dredge in Boston Harbor, East Boston.

License Needed at Terminal, Charleston, S. C.—A War Department license will be required by vessels wishing to utilize port terminal facilities when space is available. No dead storage will be accepted, and live storage will be permitted not exceeding forty days.

Breakwater, Corpus Christi, Texas.—City soon receives bids for building rubble mound breakwater in Corpus Christi Bay, involving 100,000 cubic yards stone rip rap. C. J. Howard, city engineer; R. J. Cummins, 203 Stewart Building, Houston, Texas, consulting engineer.

Repairing Breakwater and Placing Riprap, Cleveland, O.—Bids will be received until May 20, 1920, by the United States Engineer Office, Federal Building, for repairing rubble mound east breakwater and placing riprap in front of west breakwater at Cleveland harbor.

Dredging, San Francisco, Cal.—The United States Engineer Office, Fair Building, let contract for dredging part of point from Des Rios Island and vicinity near mouth of Sacramento River, Third District, to San Francisco Bridge Company, 1005 Nevada Bank Building, $388,200.

Pier, Portland, Oregon.—City let contract for building Pier 5, involving 84,000 linear feet wood pile driving, 70,000 linear feet sheet timber piling in place, 25,000 pounds dock iron and 12,000 cubic yards riprap in place, to A. Guthrie & Company, Sherlock Building, $37,865.

Dredging, Boston, Mass.—Commissioner of the Department of Public Works received bids April 2, for dredging 110 cubic yards of rock ledge from entrance to dry dock basin, from W. E. Barber, Boston, $11,900; G. T. Rendle Company, Boston and Albany Railroad bridge, $12,600; Bay State Dredging Company, 62 Condor street, $29,900.

Dredging, New York.—Murray Hulburt, Commissioner of Docks, Pier A, North River, rejected bids received March 30 for furnishing labor and material for dredging in Manhattan, Queens and Richmond boroughs. About $100,000. Let contracts for dredging in North River to F. E. Jones, 17 Battery Place, $32,780; East River, to F. S. Ross, $40,640.

Piers, Stapleton, S. I., N. Y.—Murray Hulburt, Commissioner of Docks, Pier A, North River, New York, received bids April 6 for building, (a) Pier 12, (b) Pier 13, from Smith, Hauser & MacIsaacs, 81 E. 41st street, (a and b) $2,288,089; Snare & Triest, 8 W. 40th street, (b) $1,272,596; G. B. Stearin, 90 West street, (b) $328,315; contractors all of New York.

Lengthening Wharves, Portland, Maine.—United States Engineers contemplate extensive improvements, including the lengthening of wharves along the whole waterfront in connection with the new State pier, involving an expenditure of several million dollars, in addition to the cost of the pier, which is set at $2,000,000. The necessary consent of the War Department it is expected will be given.

Dry Dock, Camden, N. J.—The erection of a mammoth drydock at an estimated cost of $3,000,000 was assured at a recent meeting of the City Council, at which it was decided to sell to Fraser, Brace & Company the two little-used streets needed to carry out the plan. Fraser, Brace & Company have purchased the dry dock from the Government and another one will probably also be bought. In the same yard will be a score of machine shops and warehouses.

Pier, New York.—Murray Hulburt, Commissioner of Docks, Pier A, North River, New York, received bids March 29 for altering pier at Fifth street, East River, etc., from Snare & Triest, 233 Broadway, $120,500; Lustig & Weil, 103 Park avenue, $124,000; associated contractors, 17 West 42d street, $131,490; water supply and plumbing from Egan Company, Inc., 217 West 13th street, $5,888; W. Young Plumbing Company, 32 Old Broadway, $6,278; Altman Plumbing Company, 802 Second avenue, $7,350.

Phosphate Terminal Plant, Fernandina, Fla.—Construction is progressing upon the $500,000 phosphate terminal plant of the Florida Terminal Company. The buildings will be of steel sheathed with corrugated galvanized iron, being on pilings, with foundations and tunnels of concrete. The crushing and drying plant will have an hourly capacity of 60 tons, while the ship-loading equipment will have an hourly capacity of 500 tons, and the storage capacity is to be 25,000 tons. Charles E. Waddell, Asheville, N. C., is consulting engineer; with him is associated F. J. Dreyer, also of Asheville.

New York Harbor.—Port committees have been appointed by the Governors of New York and New Jersey, and legislative measures authorizing an agreement between them introduced. The plan provides for a district to be known as the Port of New York, which in New York State will include practically all of the city of Greater New York and extend up the Hudson River beyond Yonkers and into Westchester County on the East River side. The port authority will have power to finance proposed projects and develop the port district in terminal transportation and other facilities. The New Jersey section of the district will include the west bank of the Hudson, the Newark Bay district and the Kill Van Kull waterfronts. Murray Hulburt, Pier A, North River, New York, Commissioner of Docks.

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SHIPPING DEVELOPMENTS

To Buy Large Freighters.—The General Steamship Company, of Seattle, Wash., is preparng to buy a number of large freight steamers for its South American service.

Fruit Steamers, Baltimore, Md.—The Baltimore & Jamaica Trading Company has placed two large fruit steamers, the Fort Morgan and Fort Gaines, on the Baltimore-Jamaica route.

Boston-Bordeaux Service.—The France & Canada Steamship Company is to have a Boston-Bordeaux service, the Shipping Board steamer Lake Frugality having been allocated for this purpose.

Coastwise Steamers.—The Carolina and East Coast Navigation Company, of New Bern, N. C., a new concern, with a capital stock of $1,000,000, plans to operate a line of coastwise steamers and barges.

Buying Tankers, Savannah, Ga.—The Terry Shipbuilding Corporation is reported negotiating to buy from the Shipping Board five steel tankers which it is completing for the Emergency Fleet Corporation. Two have been launched and three are on the ways.

Mobile-Rotterdam Service.—The Isthmian Line, operated by Norton, Lilly & Company, 26 Beaver street, New York, has begun regular communication between Mobile, Ala., Rotterdam, Holland, and ports in the Far East, with vessels built at the Chickasaw yards, Mobile.

Coastwise Service to Be Resumed.—Sailings about every three weeks giving an express service betwen New York and San Pedro, the port of Los Angeles, Cal., thence to San Francisco, are planned by the Luckenbach Steamship Company, 44 Whitehall street, New York.

Sale of Steamers, San Francisco, Cal.—The steamer Bee has been bought by the F. M. Stark Steamship Company from Fred Lindermann, and the Hornet from C. C. Mengel & Company by the S. E. Slade Lumber Company. The Bee sold for $125,000, and the Hornet on private terms.

Pacific-New York Line.—The Osaka Shosen Kaisha, of Osaka, Japan, is to operate a trans-Pacific line without subsidy from Singapore to New York by way of San Francisco and the Panama Canal. A regular vessel on the new line is now being built at the Osaka Ironworks.

Increasing Fleet, Chester, Pa.—The Sun Oil Company has added two new tankers to its fleet of eight ships; they are 430 feet long, 59 feet beam, 33 feet 3 inches deep and 10,300 deadweight tons each. The company also plans spending more than $2,000,000 in enlarging its refining plant at Marcus Hook.

Seeking Passenger Steamer, San Francisco, Cal.—E. D. Tenney, president of the Matson Navigation Company, is on his way to San Francisco from Honolulu to secure a passenger vessel for Pacific service from the Shipping Board. It is understood that a representative of the company in the East has been unable to get a satisfactory vessel.

Enlargement of West Coast Service, Boston, Mass.—Plans have been completed by the New England Maritime Corporation to enlarge its service between Boston, Philadelphia, Los Angeles, San Francisco and Seattle. Application has been made for a change in the name of the concern, which is to be known as the North Atlantic and Western Steamship Company.

Increase of Capital, Pawtucket, R. I.—The Blackstone Valley Transportation Company, of Pawtucket, R. I., has increased its capital from $250,000 to $500,000, and will handle freight shipments between Pawtucket and Philadelphia by way of the Harbor Launch Corporation Line between New York and Philadelphia. New steamers and the leasing of larger port facilities in New York are part of the development plan.

Tankers Bought, New York.—The Universal Transportation Company, Inc., Frankel Brothers, 20 Beaver street, New York, and the United States-Mexican Oil Corporation have bought five tank steamers built by the Terry Shipbuilding Company, Savannah, at a price said to be $225 per ton and are negotiating for more vessels of the same class. The sales are for prompt delivery, and the steamers will carry an aggregate of 1,500,000 barrels of oil.

Inland Marine Corporation, Syracuse, N. Y.—The Inland Marine Corporation has been formed to operate a fleet of fifty-seven cargo boats and ten steamers along the Atlantic seaboard, the New York State barge canal and other inland waterways and the Great Lakes. The New York terminal is at Pier 5, East River. The corporation is a consolidation of the Shippers' Navigation Company, of Syracuse, and the Long Island Barge Company, with a capitalization of 20,000 shares, no par value.

To Enter Mediterranean Service.—The Old Dominion Line, Pier 25, North River, New York, is preparing to enter the Mediterranean and Black Sea service with a fleet that finally will comprise twenty modern steamships, including six passenger carriers. The line will retain its piers at Beach street, North River, extending them to suit the larger ships it will acquire. Four steamers of the company, the Madison, Jefferson, Hamilton and Jamestown, are to be put in the hands of an English house for sale at auction.

Shipping Board Sales, Washington, D. C.—Five Lake type ships were sold by the Shipping Board to the Oriental Navigation Company, 17 Battery Place, New York, for approximately $2,400,000; a steel cargo ship, 7,825 tons, to the Pioneer Steamship Company, 15 Wall street, New York, $1,682,375; a cargo vessel 2,500 tons, Tropical Fruit Company, 61 Broadway, New York, $275,000; steamer, 2,875 tons, Baltimore and Carolina Steamship Company, $474,806; seagoing tug, Cuban-Atlantic Transport Company, $225,000; steamer, 4,500 tons, Medrigal & Company, Manila, P. I., $237,500; seven harbor tugs, J. W. Sullivan & Company, 827 East Ninth street, New York, $80,000 each; cargo steamer, 7,467 tons, to the American Merchant Mariners' Company, $217 per ton, less depreciation; steel cargo ship of Submarine Boat type, 5,350 tons, to Manuel Vicento Ribernio, Lisbon, Portugal, $200 per ton. Six steel sailing ships and one cargo steamer, 6,020 tons, to Victor S. Fox & Company, 47 Broadway, New York, for approximately $1,900,000, standard charter purchase plan, payments to extend over three years. Additional sales include seven ex-German and Austrian cargo ships aggregating about 50,000 tons, to Victor S. Fox & Company, Inc., and their associates, for the Consolidated Maritime Lines, recently incorporated, with a capital of $10,000,000. The purchases of the Fox syndicate aggregate about $15,000,000, and initial payments made amounted to more than $1,000,000. The board has now disposed of its entire list of thirty-four former enemy vessels, and has on hand as freighters only a small ship of 600 tons and a wooden sailing vessel.

GOVERNMENT WORK

Refrigerating Plant, Guam, P. I.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to build a refrigerating plant. About $40,000.

Submarine Base, San Pedro, Cal.—The United States Senate Committee on Naval Affairs has reinstated the item from the naval estimates appropriating $500,000 for submarine base, which has been outlined. The House Committee cut out the item, but Southern California interests had it reinstated before the bill goes to conference.

Electrical Equipment, Guam, P. I.—Spec. 4169. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to furnish and deliver 200-kilowatt turbo-generator f. o. b. Mare Island, shipped by Government Naval Station here, 10-kilowatt exciters, 775-kva. transformers, large and several small switchboards. About $32,000.

Electrical Equipment, South Charleston, W. Va.—Electrical equipment, Spec. 4146, Bureau of Yards and Docks, Navy Department, Washington, D. C., soon receives bids for furnishing and installing switchboards, oil switches and barriers, busses and connections, storage battery generator set, transformers, disconnecting motor starters and other electrical equipment furnished by Government; also making necessary connections for complete indoor sub-station ready for operation at Naval Ordnance Plant here. About $195,000. $10 deposit required for plans and specifications.

FOREIGN MARITIME MATTERS

Mines in the Kattegat.—It is reported that the Kattegat, between Tistlarna and Paternester Skaeran, is full of floating mines, probably torn loose by recent gales.

Amalgamation, Halifax.—It is reported that an amalgamation of the steel companies, Canada Steamship and the Halifax Graving Dock, now operated by the Halifax Shipyards, is to be effected.

New Shipbuilding Company, Vancouver, B. C.—A new shipbuilding company with a capitalization of $1,000,000 has taken over the British Columbia Marine Ways of Vancouver and will make extensive alterations and improvements.

Shipbuilding Plant, Three Rivers, Quebec, Can.—The National Shipbuilding Corporation has let wood piling contract and erecting 95 by 340 feet shipbuilding plant on River Road to the Raymond Concrete Pile Company, 10 Catherine street, Montreal; $100,000.

Turbine Steamers, Birkenhead, Eng.—Cammell, Laird & Company, Ltd., Birkenhead, Eng., have booked an order for two geared turbine steamers for the Osaka Shosen Kaisha, of Nagasaki. They are to displace 15,000 tons and will have a sea speed of 13 knots.

Harbor Headwalls, Toronto, Canada.—The Toronto Harbor Commission let contracts for building harbor headwalls from York to Bay streets to Weddell & Saunders, McArthur Construction Company, 36 Toronto street. About $1,500,000. Work involves 125,000 cubic feet reinforced concrete.

Shipyard Merger, Newcastle-on-Tyne.—The Newcastle Shipbuilding Company, Ltd., has taken over the business of the Huntley Shipbuilding and Repairing Company, Ltd., at Hebburn. The new yard of the Newcastle Company has a river frontage of 1,600 feet and a depth of nearly 1,000 feet.

Subsidy, Iceland.—A proposal for the State contribution of 30,000 kroner for the establishment of a steamship service between Gothenburg, Sweden, and Iceland has been introduced in the Iceland Parliament. The contribution is, however, conditional on the Swedish Government granting a similar sum.

Port Improvements, Dominican Republic.—Vice-Consul George A. Makinson, at San Domingo, reports that the Dominical Republic has completed a number of wharves,

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bridges and other improvement work in the last two years, and that a large amount of similar work is being planned for the immediate future.

Marine Finance Corporation, London.—The Merchant Marine Finance Corporation of London has been formed for the purpose exclusively of financing shipbuilding. Directors include Sir Frederick Hall, chairman; Sir Edward Mountain, managing director, and Sir John Esplen, director of Furness, Withy & Company.

Steamship Merger, London, England.—G. Instone & Company, Ltd., of London and Cardiff, Wales, managing owners for the Instone Transport & Trading Company and the Woolston Steamship Company, Ltd., has purchased the Woolston Steamship Company, owner of a fleet of 20,000 tons afloat and several vessels building. Price is nearly £1,000,000.

Motorship, Sweden.—The Sound yard at Landskrone in Sweden, which is Danish owned, is to build an 8,000-ton motorship to be fitted with Burmeister & Wain Diesel engines. It is interesting to note that this shipyard has hitherto specialized in the construction of the modern type of turbine steamer with reduction gear, and the change is therefore significant.

Steamships for West Coast.—It is reported that two steel freighters have been ordered from British builders for the South American-Pacific Line by Seattle headquarters of the company. One is of 7,000 deadweight tons, and will be built by Robert Thompson Company, Ltd., of Glasgow, and the other, of 6,700 tons, will come from the Clyde Ship & Engine Company, Glasgow.

Electric Power at Leith Docks, Scotland.—The Dock Commissioners of Leith will install at the Albert dock a steam turbine-driven generator of 1,500 kilowatts capacity to take the place of the present gas-driven engines; cost, about £40,000. The reconstruction of the wall of the outer harbor near the Prince of Wales dock has been authorized at a cost of £19,000.

Dock Improvements, Liverpool.—The Mersey Docks and Harbor Board is to provide electrical elevators, conveyors and other equipment at the grain warehouses at a cost of £35,000. The entrance to the Alfred dock, Birkenhead, is to have a new lock 600 feet long and 80 feet wide, with three pairs of gates; the outer locks will be closed. The improvement is to cost £680,000.

Shipping Deal, Liverpool.—It is reported that T. and J. Harrison, of Liverpool and London, have acquired the fleet of Prentice, Service and Henderson, of Glasgow, and Scrutton, Sons & Company, London. Of the thirteen vessels purchased, all especially adapted for the West Indian trade, seven were taken over from the Glasgow firm, with an aggregate tonnage of 36,000 tons.

Port Improvement, Bari, Italy.—The Italian Ministry of Public Works has allotted 84,125,000 lire for port construction at Bari. It is intended to make the city the most important harbor on the Adriatic. An administrative board has been organized and 16,000,000 lire set aside to develop Porto Maurizio, on the Gulf of Genoa, to serve the maritime interests of the Piedmont region and generally of Northwest Italy.

Ship Repairing, Jarrow-on-Tyne.—The Mercantile Dry Dock Company, Ltd., has bought the eastern portion of the Chayters estate for the extension of its business. The property covers about 100 acres and adjoins the Mercantile Company's present property, with an extensive front to the river. It is regarded as possible for the new owners to create the largest repairing shipping establishment in the United Kingdom.

Shipyard Extension, Greenock, Scotland.—Plans for the extension of the shipbuilding industry at Greenock, which are backed mainly by Harland & Wolff, have passed the British Parliament. The work will require about three years to complete, and will cost between £2,000,000 and £3,000,000. The Parish Church and church yard will be removed, the church erected on another site, and a number of streets widened.

Port Improvements, Vigo, Spain.—Propositions for the construction of an extensive port at Vigo have been approved by the Spanish Ministry. This work is to be done to facilitate the constantly-increasing commerce of the port. A royal decree has been signed authorizing the issue of a 100,000,000 peseta loan for the building of docks, which, it is reported, will be constructed by a New York firm. It is rumored that American financiers have agreed to subscribe a considerable portion of the loan.

Bunker Coal, England.—Bunker coal at the port of London is selling at 155 shillings per ton. Coal for British industrial works is selling at the controlled price of 40 shillings per ton, and equivalent quality bunker coal at 140 shillings per ton. Since last May the price of bunkers has risen by 100 shillings per ton, while ordinary cargo freight rates are practically unchanged. There is a movement in progress to advance the outward freight rates from the United Kingdom by 50 percent if bunker prices cannot be lowered.

Auxiliary Sailing Ship, Leith, Scotland.—Before the war a 5,000-ton auxiliary sailing ship was under construction at the yard of Messrs. Ramage & Ferguson, Leith, for the East Asiatic Company, Copenhagen, Denmark, in which Diesel engines of the Burmeister & Wain type were to be installed. This vessel was taken over during the war by the British Admiralty. A similar ship is being built by Messrs. Ramage & Ferguson. One of the main reasons for building this craft is to provide a means of practical training of engineers for the East Asiatic Company.

New Shipbuilding Berths, Tyne, England.—The Tyne Commissioners have sanctioned construction of three shipbuilding berths, 128 feet, 210 feet and 285 feet long respectively, by the Newcastle Shipbuilding Company at Hebburn; also for a ferro-concrete quay at the Renwick and Gradwish yard at Hebburn; for the renewal of the dock gates and walls of the No. 1 dry dock of John Readhead & Sons, Ltd., of South Shields, and temporary extensions to three building berths and the laying out of two additional building berths at the Bill Quay yard of Wood, Skinner & Company.

Ship Construction, Bristol Channel, England.—A private firm, understood to be Vickers, Ltd., is reported to have secured a lease for thirty years for the Pembroke Dock Yard from the British Admiralty. It is planned to make the dock yard a merchant ship construction plant. It is reported that the Llanelly Patent Ship, adjoining the Carmarthenshire Dock has been secured by a company for shipbuilding purposes. The National shipbuilding yard at Chepstow, on the Severn estuary, has been sold to a company which proposes to build ships and utilize the tidal range of more than forty feet to produce electricity for commercial use.

Motorships, Glasgow.—The British India Steam Navigation Company, of London, is having two motorships built by Barclay, Curle & Company, of Glasgow, and one by Robert Duncan & Company. They are 450 feet long, 58 feet beam, 35 feet deep, with a draft of 27 feet 11 inches when loaded to their capacity of 10,670 tons. Each vessel will have two 8-cylinder engines, built by the North British Diesel Engine Works, of 2,300 indicated horsepower each. The cylinders are 26½ inches diameter, 47-inch stroke, with a speed of 96 revolutions per minute. One ship will have 18½ knots' speed and the other two 12½ knots, the difference being accounted for by the fact that in the first case the engines have independent compressors, and in the second the compressors are on the main engine.

Large Motorship, Holland.—The Dampskib Storford, A. S., of Stavanger, Norway, has placed an order for a motorship of 9,500 deadweight capacity with J. & K. Smit, of Kinderijk, Holland. She will be 439 feet 8 inches over all, 57 feet 1 inch beam, 27 feet draft. Twin-screw Werkspoor machinery will be installed, comprising two 2,140 indicated horsepower 6-cylinder engines, with cylinders 670 mm. bore and 1,200 mm. stroke, running at 110 revolutions per minute. These are the highest powered engines of the Werkspoor four-cycle type that have yet been built, and three other sets are under construction for single-screw ships, the San Andres and the Sardinia, for the Otto Thoresen Line of Christiania, and a new vessel for Winge & Company, also of Christiania.

British South Africa.—Extensive harbor improvements have been approved for African ports which will probably cause a demand for modern harbor equipment at Table Bay. Purchase of a crane of 50 to 100 tons capacity is being considered; a 633-foot quay, with a low-water depth of 38 feet and carrying a large warehouse, is being constructed, and the reclamation of a area of about 140 acres will increase docking facilities. A graving dock 1,140 feet long, 110 feet wide, with 35 feet depth for the sill at low water, is planned for Cape Town. Several piers on the north side of the harbor, with warehouse accommodation and extension of the present jetty, are planned for Algoa Bay. At East London, rock in the Narrows is being removed, and partial removal of the east training wall is projected. A graving dock is in process of construction at Congella, and plans call for the extension of the wharf to a low-tide depth of 40 feet. Other wharves planned will provide 1,150 feet of berthing space for vessels drawing up to 38 feet 6 inches, and efficient coaling appliances will be installed. a quay and fuel oil tanks are also to be erected.

Breakwaters, Wharves, Etc., Ontario, Canada.—Dominion Government, Ottawa, plans to making the following improvements in the Province of Nova Scotia: Repairs to breakwater, Devil's Island, cost $13,000; West Chezzetcooke, $15,000; reconstruct breakwater, North Ingonish, $11,000; harbor improvements, Inverness, $12,000; wharf, Sydney, $100,000. Province of Quebec, wharves—Anse aux Gascons, $36,000; North Temiskaming, $13,000; Grosse Isle, Quarantine Station, $50,000; Pointe Pizeau, Sillery, $13,000; St. Ann de Beaupre, $30,000; St. Famille, $17,000; St. Francis Sud $33,000; St. Jean d'Orleans, $31,000; St. Laurent, Island of Orleans, $21,000; St. Michel de Bellechasse, $36,000; Sorel, $10,400; piers—Grande Riviere, $12,900, Pointe Shea, Amherst, $10,000; harbor improvements, Rimouskie, $13,000. Province of Ontario, breakwaters—Collingwood, $50,000; Port Colborne, $66,500; wharves—Kagawong, $12,000; Oshawa, $15000; piers, Rondeau $17,000; harbor improvements, Port Stanley, $19,000. Province of British Columbia, improving lower Fraser River, $25,000; wharves—Kincolith, $11,000; Powell River, $11,000. Province of Prince Edward Island, boat harbor, North Lake, $27,000; breakwater, Souris, $40,000. Province of New Brunswick, repairing breakwaters and piers, Cape Bald, $10,000; repairing breakwater—Petit Rocher, $15,000; Shippigan Gully, $12,000, reconstructing breakwaters and repairing pier, Quaco (St. Martin's), $22,000. E. Lafleur, care of Department of Public Works, Ottawa, engineer.

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